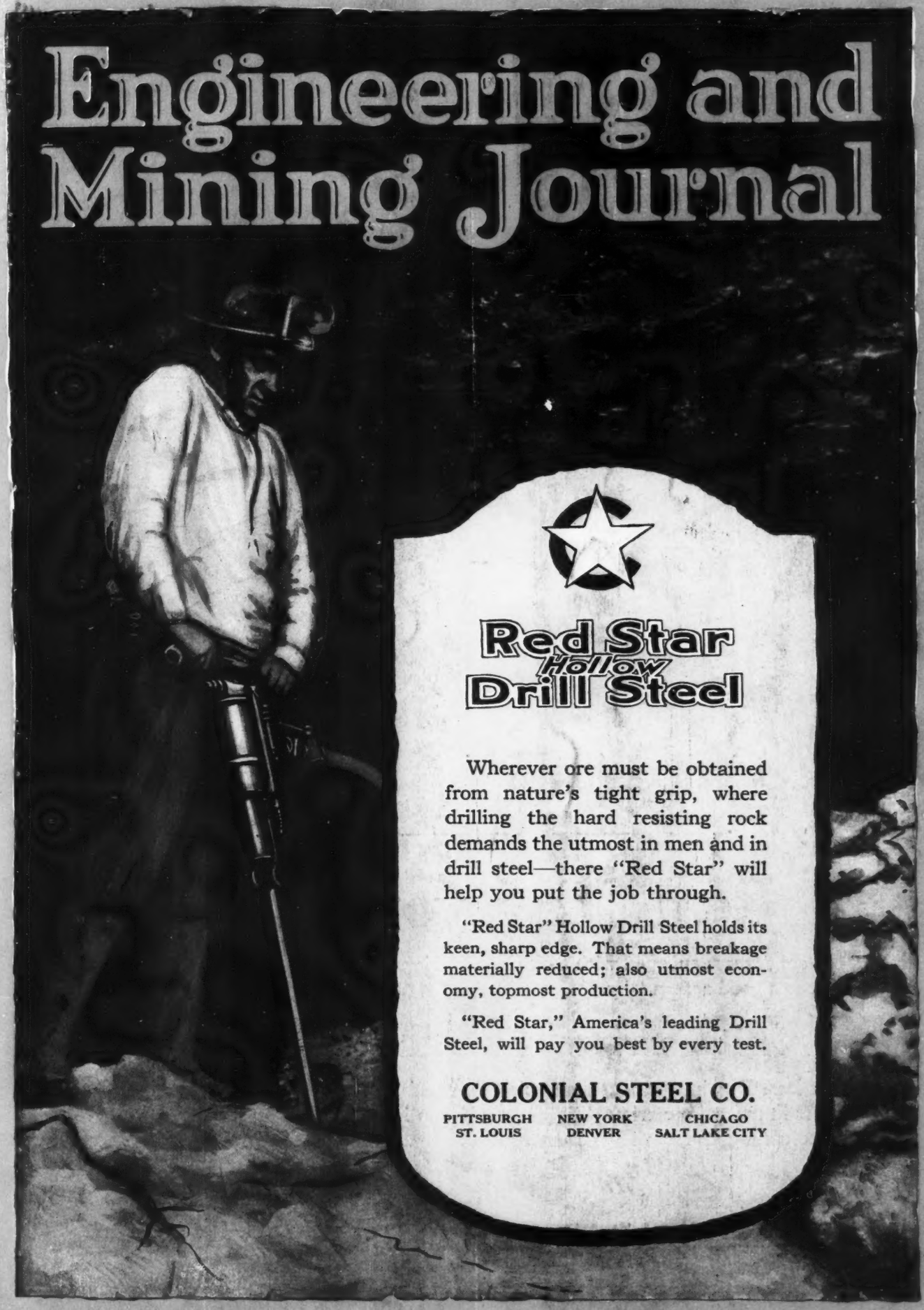
SCIENCE LIBRARY

McGRAW-HILL Co., Inc. Price, 20c. New York, September 20, 1919

GENERAL LIBRARY
SEP 22 1919

Engineering and Mining Journal



Red Star Hollow Drill Steel

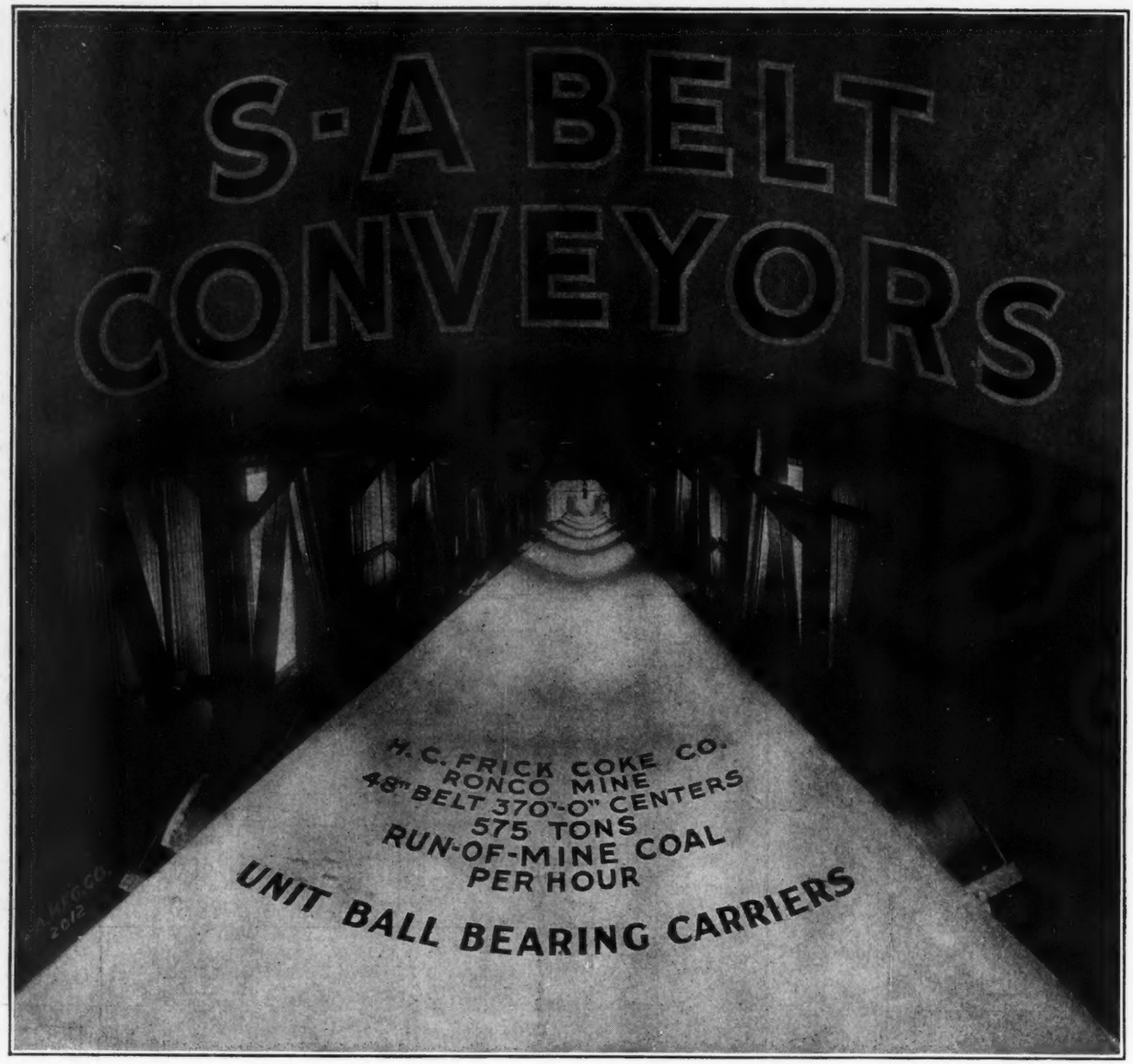
Wherever ore must be obtained from nature's tight grip, where drilling the hard resisting rock demands the utmost in men and in drill steel—there "Red Star" will help you put the job through.

"Red Star" Hollow Drill Steel holds its keen, sharp edge. That means breakage materially reduced; also utmost economy, topmost production.

"Red Star," America's leading Drill Steel, will pay you best by every test.

COLONIAL STEEL CO.

PITTSBURGH NEW YORK CHICAGO
ST. LOUIS DENVER SALT LAKE CITY



Real Conveyor Service

Belt conveyors equipped with S-A Unit Carriers last longer and there is a good reason why.

Unit Carriers are All Steel

Unit Ball Bearing Carriers are being installed on the big conveyors in many industries. They are made up in various styles, for belts ranging from 12 to 60 inches in width.

Do you receive our monthly house organ, "The Labor Saver"? Write for a copy.

Write for prices.

STEPHENS-ADAMSON MFG. CO., AURORA, ILL.

Engineering and Mining Journal

H. C. PARMELEE, Acting Editor
WALTER RENTON INGALLS, Consulting Editor
GEORGE J. YOUNG, Western Editor
D. E. A. CHARLTON, Managing Editor
A. H. HUBBELL, E. P. McCROBKEN, EDWARD H. ROBIE, HARRY J. WOLF, Assistant Editors

Volume 108 — New York, Saturday, September 20, 1919 — *Number* 12

Market Report for Sept. 20 Will Appear in Issue Of Sept. 27

INDUSTRIAL conditions in New York have made it expedient to close the forms of the *Journal* in advance of the routine schedule date. The usual market quotations are therefore necessarily omitted from this number. The market pages which would have appeared normally in the Sept. 20 issue will be published in the *Journal* of Sept. 27.

Present Status of Deep Mining in California

IN COMMENTING upon the present unsatisfactory condition of deep mining in California, Charles G. Yale, of the U. S. Geological Survey, assigned the following causes: Low prices of metals produced (and this applies to gold, on account of its low purchasing power); strikes and scarcity of labor generally; high taxes and other war conditions; surcharge on electric power allowed the power companies. His statement applies to gold, copper, lead, and zinc mines in California.

With the first three causes the mining industry in all of our metal-mining states has had to contend. As far as prices are concerned, the individual mine must sell its products at the ruling quotations, which are determined by economic conditions. This ruling price and the weight of metals produced determine the gross income of the mining company. Out of this gross income, needless to say, must come wages, taxes, salaries, supply and material costs, power cost, and overhead expenses, as well as any gain to the stockholders of the enterprise.

Gross incomes of mines have been greatly diminished, both from the lower prices of metals and also on account of curtailed production. Many gold and copper mines have closed down in California as a consequence of their inability to conduct operations under the existing conditions, except at a serious financial loss. Other mines are operating without profit. Whatever mines show an operating profit are indeed fortunate.

Under the circumstances labor strikes are particularly to be regretted. Their continuance will not better the status of labor nor improve the position of any individual mine. There are loss in time, deterioration in underground workings, failure to make necessary repairs in equipment, disorganization of the working force, and discouragement of the operating staff, not to mention the inevitable ill-feeling that accompanies the fighting of such questions to a settlement. A mine working on a narrow margin becomes a losing venture after a few such experiences.

Large low-grade properties do not attain low operating costs at once, but must pass through a period during which there is co-ordination of effort and a development of plant and labor efficiency that require great skill on the part of a managerial staff. As this is attained, a margin between income and expenditure appears, and the enterprise becomes profitable. It takes a surprisingly small thing to throw the machinery out of order. It requires great patience and hard work to bring it back. If the men who go out on strike with apparently so slight concern would assume the responsibility which is rightly theirs by reason of their participation in the mining industry they would exhaust every reasonable expedient before striking. How many of the striking miners have sought to join forces with the communities in which they live in an endeavor to reduce living costs? Yet this is an eminently practicable way of increasing the "ruling wage." We know of mining companies that have kept down food and living prices in mining communities. It would be the part of wisdom for the mine workers to join forces with the mine management in a campaign to reduce living costs rather than to throw the burden upon the mine to pay increased wages.

In respect to high taxes, mining enterprises must pay their full share not only of the local and state taxes but also of the Federal taxes. The future does not hold forth the prospect of speedy reduction in the amount of the tax. It is not probable that the cost of mining supplies will be reduced materially. In the case of California mines, increases in the cost of power which is served to the mines by public-utility corporations have been made, and have had their influence in making profit margins smaller.

The big mine has played the part in the past of lending stability to the mining industry by providing steady employment to large numbers of mine workers. It will continue to do this if it has a reasonable chance to make expenditure less than income. The product of the mine must be sold in competition in the metal markets of the world. Unlike a public-utility corporation, the mine cannot pass on increased labor and supply costs to the metal consumer. Such increases almost always decrease the margin of profit, and the danger point is apparently being approached.

Both large and small mines need the active co-operation of the mine worker with the mine management, if the mining industry is to prosper.

Scientific Information In the Daily Press

THE quality of the technical information supplied by the general press is such as to provoke amusement among the comparatively small proportion of newspaper readers who have had scientific training. In some cases the reporter, or rewrite man, or whoever prepares such articles, apparently knows nothing whatever about the subject on which he writes, and statements are made which have no foundation in fact. In other instances—and here we find the most amuse-

ment—he has absorbed the gist of some feature of applied science, and in an effort properly to describe it in technical language he unconsciously wanders far afield. He means well, but his manner of expression is as unfortunate as that of the young man who passionately declared to his sweetheart, "If beauty is only skin deep, then you have a hide like a rhinoceros"!

Many scientific societies and Government bureaus furnish press bulletins on technical subjects, and the more careful newspapers look to such sources for material, rather than trust writers of limited familiarity with the subjects discussed. As an example we might cite an article on the "Deepest Well in the World," recently prepared by the U. S. Geological Survey, and contained in their Press Bulletin for August, an excellent article, which was reprinted by the *New York Times* and other lesser papers.

Information on technical subjects is often valuable and interesting to the layman, but it should come from an authority. The source also should be shown whenever possible, if for no other reason than to establish the status of the article in question.

As Others See the Engineer

A FEW weeks ago M. O. Leighton, chairman of the Engineers, Architects and Constructors' Conference on National Public Works, reported the opinion of a statesman and politician of the better class upon the effort to establish the National Department of Public Works. The opinion contains an interesting estimate of the engineer and is quoted below:

"Your task is appalling. You have been elected to lead engineers into a political reform. They are the most unresponsive citizens we have. Your organization has a praiseworthy purpose, but if it were sponsored by almost any other group of reputable men than engineers there would be more promise of success. If your organization succeeds I believe you will find that it will not be the engineers who have carried it through. Their aloofness and indifference in all matters outside of their own professional sphere are among the unexplainable things in our political life."

The engineer as a representative of a class has of late been the recipient of a considerable amount of advice, the burden of which has been that he ought, for the welfare of the community, as well as for his own, to give more attention to public affairs and in more direct ways associate himself with politics and even political office. To see himself as others see him and to learn that he is unresponsive, aloof, and indifferent, according to our statement quoted, is not exactly pleasing. A more flattering account would be pleasanter. The results of the statesman's essay will be accepted by some, but many, among whom we place ourselves, will be inclined to take issue with the statesman on the ground that he has not taken an accurate sample, but rather has grabbed a "specimen" from the pile which cannot give the result that would have been obtained from a sample.

That engineers as a class are unresponsive is disproved by the attitude of engineers toward the war. They were among the first to volunteer their services, and from the illustrious Herbert C. Hoover to the engineer in the ranks of the American Expeditionary Force there was a hearty response to the needs of the situation. That engineers hold themselves aloof is in a measure true, for most engineers thoroughly dislike to mix into the mire of politics.

Engineers are not indifferent to public affairs. In many instances it is the observation and the initiative of the engineer that are responsible for improvements in public service. It goes almost without saying that the idea of a National Department of Public Works comes from the engineers, and, through their organization, the Engineering Council, a strong effort is being made to put the idea over.

The opinion of our statesman-politician is worth examining further. Is it not a clever way of side-stepping a responsibility for a condition in the Federal departments for which the politician has primarily been responsible and for which he has been called to time by the engineers? It is begging the question to say that the task is appalling when viewed from the standpoint of the engineers getting back of the movement for a political reform. Would it be less appalling if the politicians were to actively interest themselves in the question? Is there anywhere a proffer of assistance from our statesman-politician to the engineers? No. All that there is, is a shrug of the shoulder and "Your task is appalling because engineers are unresponsive, aloof, and indifferent."

On the other hand, are politicians responsive, in touch with the public weal and attentive? They are, but as far as we are informed most of them are responsive and attentive to only two things—votes and a strong desire to remain in office. They are in touch more with the public pocketbook than the public weal.

We are glad to see that the engineer is interesting himself in public questions. We know that the task will not be appalling to him, for he has faced many a problem in bridge building, tunneling, construction, and management, and the brain power which he has brought to this work will, we believe, prove equally effective when applied to public questions.

Technical Graduates And Plant Management

TECHNICAL graduates sometimes manage a plant as if it were an experimental laboratory. Part of their training has been in the laboratory, and it is natural that they should acquire the laboratory habit. There is a fascination about experimentation from which it is frequently hard to get away. We do not take issue with this, but we do desire to point out that there is necessity for discrimination. In the operation of a plant it is essential to decide upon a general plan and to carry this out until every detail has become a part of the plan and the working force has been so thoroughly drilled and broken in that a high degree of efficiency is the rule, and everyone in the plant knows exactly what is expected of him. Individual dexterity and skill are the outgrowth of repeated performance which finally reaches a stage under skilled direction when everyone fits into the system easily. Commercial results require plant operation of this order. There is always the breaking-in period of a new plant. During this period unit costs are high and efficiency is low. The more quickly this is passed the sooner will unit costs begin to decrease.

Experimental work properly belongs at the beginning of operations, and at this time the limitations of ore treatment should be worked out in the laboratory by systematic experiments. A knowledge of the type of

ore deposit will convey some indications of the changes to be expected in the constitution of the ore with deeper mine development. Provision can be made at the beginning for radical changes in ore constitution. Flow sheets can be devised from the experimental data.

During the operation of a plant, experimentation may be necessary, but a sharp line should be drawn between the operating force and the men who are conducting such experimental work. Only in rare instances should the line be crossed and interference with regular operation allowed. It is easy to disorganize, and hard, as well as expensive, to return to established routine. Where radical changes are necessary they should be effected promptly, and the working force brought to the new operating routine as rapidly as possible. The technical graduate who recognizes these principles and puts them into practice will earn money for his employer and win recognition as an able manager.

For the Freshman in Our Mining Schools

WITHIN a month the numerous schools of mining scattered throughout the country will be open, and another year's supply of mining and metallurgical engineers will be in the making. Most of these students will come from mining districts or from families one or more members of which have been interested in mining.

Secretly, most men feel that some other calling presents much greater opportunities than their own—the miner envies the commission merchant, with his attractive city or suburban home and nothing to do but buy goods and sell at an advance. And the latter thinks it would be ideal to get away from his confined environment; to ramble about in the open where riches lie buried in the ground and can be had for the digging. Desire for the other fellow's job is a human frailty, but the fact remains that most men, in selecting a profession, are inclined to embark in one with which they are already fairly well conversant. So, as we said, most mining engineers become such from environment. The embryo engineer will go to a mining school and take the course there offered; then he will begin or resume his practical work, and he will know little else than mining.

The profession would be benefited in many ways if more mining engineers were graduates of literary, law, or even medical schools. At least, the mining-school student should endeavor to secure as broad a course as possible. He will find that 95 per cent of the problems he will have to solve depend on plain common sense and experience applied to the elements of mathematics, physics, and chemistry, principally plain common sense. So he should go to a school that offers something besides strictly mining courses, and he should make the most of his opportunities. When it comes time to write for a job, the plum will go to the man who writes the best letter and the gooseberry to the one who drew "A plus" in the science of ore concentration.

One of the principal things a mining engineer is called upon to do today is to handle labor; and to do this he must understand psychology and social problems. He must also be a business man; which means he must have a good working knowledge of economics. And, in general, the higher a man gets in his profession, the more varied his education must have been.

So we say to the prospective student: Do not specialize too closely, and do not scoff at the "arts" student. He may be a wise engineer.

Wildcat Advertising

IN THESE DAYS, when so much is being said of "blue-sky" legislation, and stringent laws have been passed, and in some cases are actually being enforced, it is apparent that something is being done to discourage picking the public's pockets. But the millennium is still a long way off. Audacious advertising of oil promotions and other schemes frequently comes to hand. Attention has been called from time to time in these pages to advertisements that were so impudent as to be actually funny. Indeed, so lurid and barefaced have some of them been, that it seems that even the most credulous would pass them by with a laugh. This advertising has not been limited to any particular section, the most flagrant cases noticed having come from Utah, Connecticut, and Texas.

The Ontario government recently instituted prosecutions under the Ontario Companies Act against four promoters dealing in oil shares of companies of doubtful standing, and one of them has already been convicted. The action taken by the California State Corporation Department on Aug. 4 in issuing a list of companies which have failed to comply with the California Securities Act has been discussed in a previous editorial.

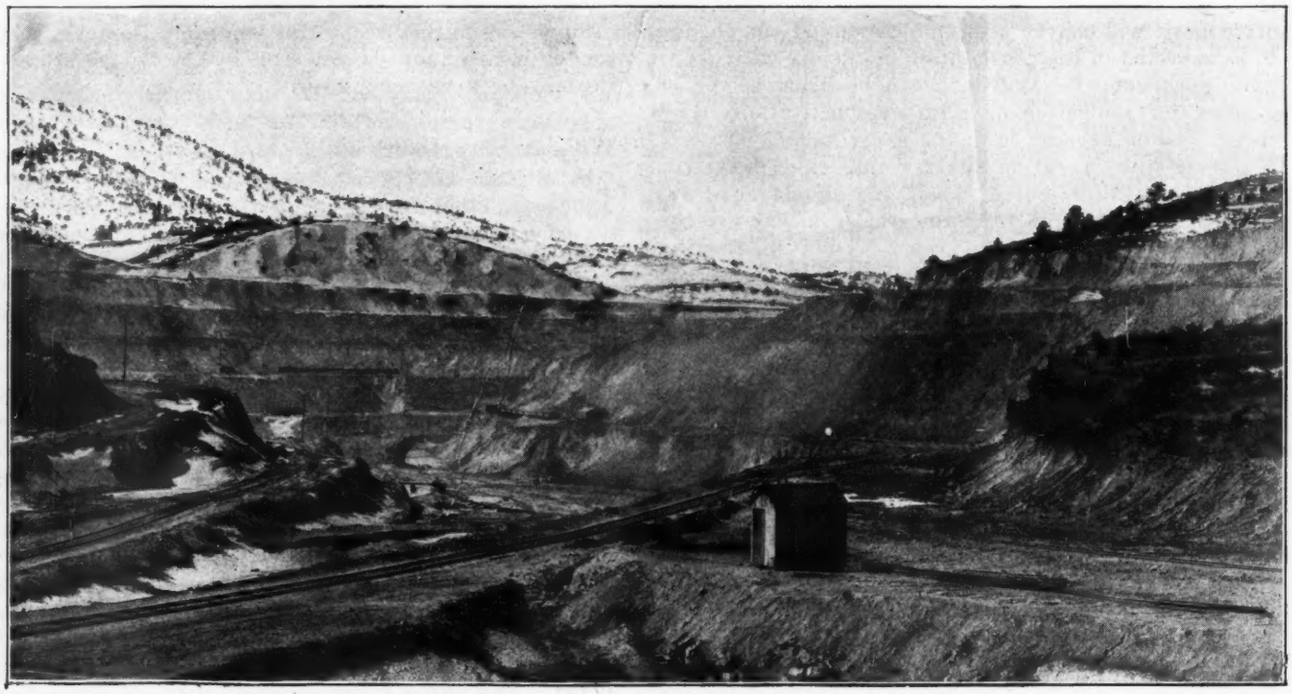
It is not enough, however, to punish the guilty promoter. The agency that prepares the advertisement of a promotion that is bogus on its face, and the newspaper that gives it space, are to a considerable extent partners in the crime. Business it may be, but it is dirty business.

Engineers throughout the country can do much to make the going more difficult for fake promoters. Most of the cases brought to our attention, in fact, have been exposed by members of the profession in the various sections. The crook who wants publicity should have publicity, but it should be of the sort he deserves. Fake promotions injure the mining industry and the engineer himself.

Daylight Saving In Mining Communities

THE advantages of the "Daylight-Saving" Law have been discussed extensively. We believe that practically all mining communities are sorry to see the law repealed; in fact the farmers seem to be the only class which has been made happy. It was a case of determined opposition of a minority overthrowing the half-hearted support of a majority.

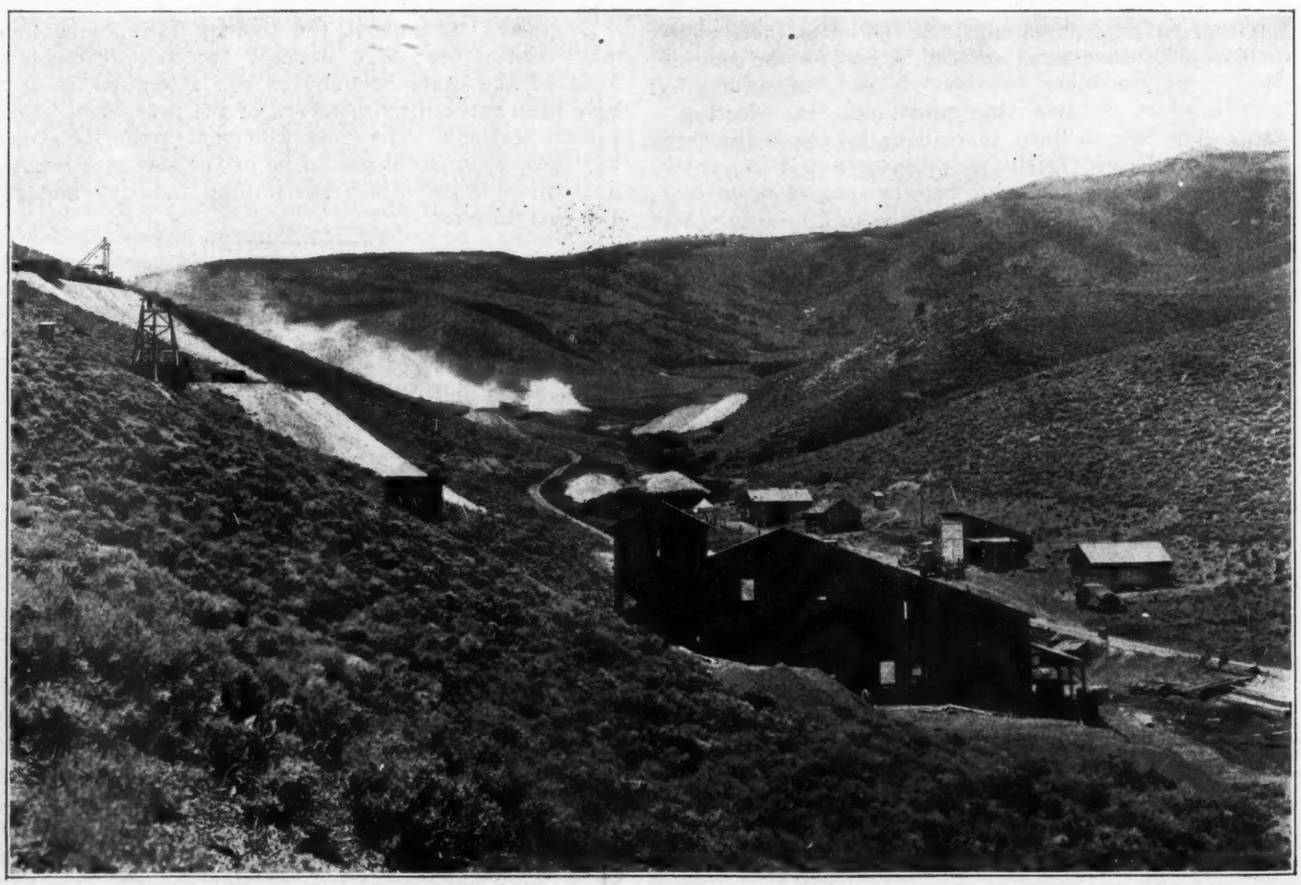
To the men working on shift there was probably no particular advantage in the scheme, but to others it threw the work one hour further into the cooler portion of the day, and gave an extra hour for outdoor activity and recreation. Most mining communities are self-contained, and local "daylight saving" can easily be continued next year if the residents of a district wish it. To avoid confusion with railroad time, it might be advisable for the various mining companies merely to ask men working always in the daytime to report one hour earlier. Then there would be no need to change the clocks. Local communities may secure all the advantages of "daylight saving" by adjusting the hours of employment.



LIBERTY PIT OF NEVADA CONSOLIDATED COPPER CO. AT COPPER FLAT, NEV.

Photographs From the Field

THE PEAVINE MINE OF THE STANDARD METALS CO. NEAR RENO, NEV.



The Diesel Engine in the Southwest

The Economy of Power Secured From This Source Compared With That From Steam—Principal Troubles Encountered in Oil-Engine Operation—Necessity Of Employing Trained Operators

BY B. V. E. NORDBERG

IN THE southwestern mining country, the Diesel engine may be employed under conditions to which it is particularly well adapted, as little fuel is available other than fuel oil, the bulk of which is shipped from the Californian fields. The two principal kinds which are used are a light grade about 25 Bé. and a heavier variety of from 19 to 14 Bé. The same grade of fuel is used for both steam and Diesel plants, so that a direct comparison can readily be made between economical installations of both types. East or west from the southwestern mining district, there are oil fields, and, with the lessened price of fuel, the cost of operating large steam installations more nearly approaches that of maintaining the Diesel plant. In small units, however, the steam plant is not economical, and small oil engines may find considerable application in the oil districts, as there is little difference in fuel economy between oil engines of different sizes. However, where the climate is cold and heating must be considered, the Diesel engine is of limited applicability.

A properly designed and well-constructed Diesel engine is economical not only in fuel consumption but also in maintenance. Still, no engine, however well built it may be, can deliver cheap power if the attendants are not capable, careful, and trained in the handling of such units. In this age of slight experience with oil engines, good construction is essential, and even more so in the mining field, where continuous operation is necessary. The wheels in a mining camp do not stand still for months at a time, and the problem involves a spare unit, without which no mining power plant should be designed. The larger mining companies understand this well, but the smaller ones usually believe they cannot afford a spare unit.

The electrification of all branches of mining is responsible for making the use of the Diesel engine a big factor in the reduction of cost of power. With an electric hoist installed and a mill driven by motors, the problem is simple, and the engine is usually direct-connected to a generator. With several engines running in parallel, no difficulty whatever is experienced, so that any number of units can be put into the same power house. The only limit is the economical number of units. The smaller the unit for a given type, the greater will be the cost of foundation, building, generator, and accessories. A multiple unit system is a logical method of installation, as it makes a more flexible plant and cuts down the size of the spare unit.

500 B.HP. PER CYLINDER THE SIZE LIMIT

The question of how large a Diesel engine can be built is still undecided; for marine work the general belief is that the larger the engine the better. A limitation may be set, however, on the size that may be of economic value to the mining industry today. Those central power houses distributing to large mills and hoisting plants would demand as a maximum an oil engine capable of delivering about 500 b.hp. per cylinder. Such units can be built with from three to six cylinders. A larger number of cylinders than six is of questionable advantage, owing to the added complication and attention required by the adjustments. More than six cylinders may be suitable to certain types of engines, but, considered purely in the light of a large number of cylinders compared with a few cylinders, the engine with the smaller number possesses the advantage.

POWER INCREASED BY USE OF SCAVENGING PUMP IN HIGH ALTITUDES

Diesel engines in mining districts are usually installed in high elevations, and the maker must proportion his engine sufficiently large to meet the low atmospheric pressure. The amount of fuel that the engine can burn per stroke is less in high elevations than under pressure conditions present at sea level. In the two-cycle type of engine illustrated in Fig. 1, the reduction in power caused by high altitude can be lessened to a considerable extent by supercharging the cylinder with clean air from the scavenging pump, the position of which is shown in Fig. 2. The pump merely compresses air to a pressure of about 4 lb. per sq.in., which, in this type of engine, is led to the cylinder head through a header and blown through the cylinder when the four valves in the cylinder head are simultaneously opened.

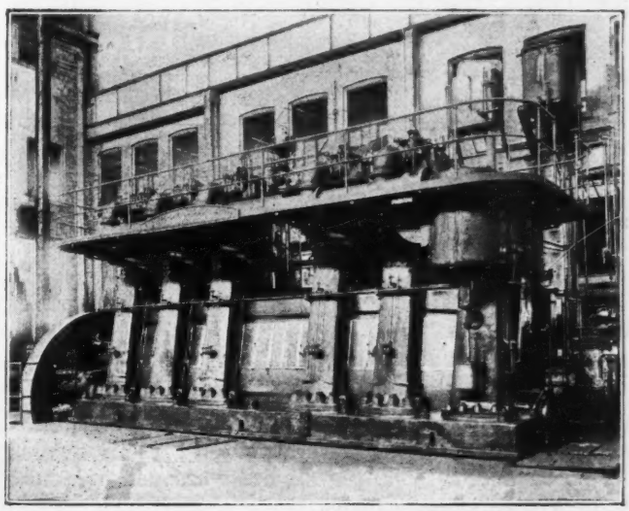


FIG. 1. A FIVE-CYLINDER TWO-CYCLE ENGINE RATED AT 1,250 B.HP.

The scavenging air is evenly distributed, flowing downward in an almost solid sheet, and expelling before it the burned gases. This blowing continues until the exhaust ports are covered by the piston. The scavenging valves are so timed that they remain open after the ports are covered, so that an additional amount of clean air is admitted to make the pressure equal to sea-level conditions. With this arrangement the same quantity of fuel per stroke can be burned, regardless of elevation,

the only loss being the additional power required to compress the increased amount of scavenging air. This amounts to the same thing as an additional friction load on the engine, and its rating is reduced by just that amount.

The high-pressure compressor furnishing blast air requires a little less power when compressing air at high elevations, even though the pressure range is greater. The fact that the power of the engine is not greatly reduced is a point of considerable advantage. An engine such as is shown in Fig. 1 is rated at 1,250 b.hp. at sea level. It has five working cylinders of 250 b.hp. each, the sixth illustrated being the scavenging air pump.

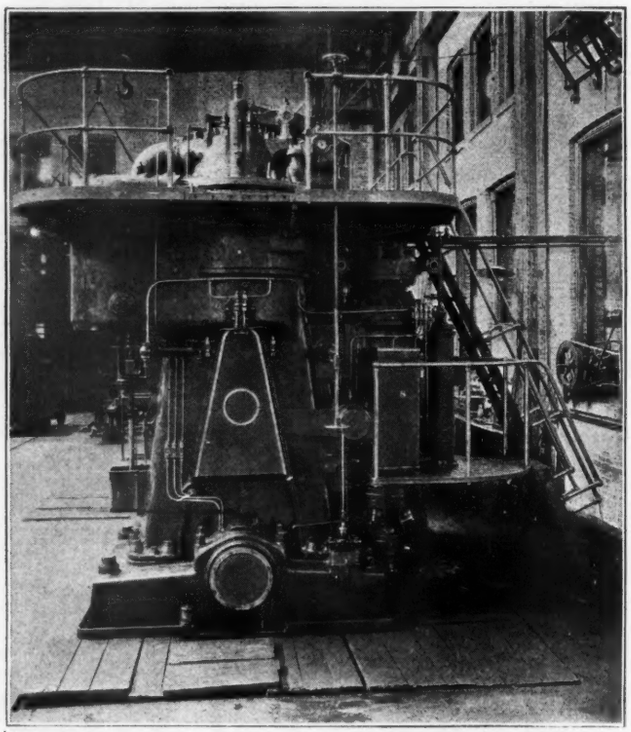


FIG. 2. END VIEW OF DIESEL ENGINE, SHOWING SCAVENGING PUMP

At an elevation of 5,950 ft. the unit has pulled peak loads of 900 kw. lasting several minutes, easily holding its speed and without the slightest amount of smoke being visible in the exhaust.

Despite the fact that a two-cycle engine has the advantage of being able to develop more power, it is good policy to overtax it as little as possible. In mining work, the loads as a usual thing are comparatively constant. A load factor of between 60 and 70 per cent is not unusual, and it often remains at that figure for weeks at a time.

With several units, a plant may be operated with a load factor of 90 per cent or better. In fact, if given a conservative rating all of the engines illustrated in Fig. 1 operated at above 95 per cent. The unit under any consideration must be able to hold its load easily, and it must be borne in mind that the Diesel engine is a maximum-rated machine in the strictest sense of the word. The maximum rating has been determined only after long experience, and is not the maximum load which the engine can pull, as is sometimes mistakenly supposed. It is such a rating as will cause no trouble due to either excessive heat or diminution of load capacity in time, other conditions being good. It has finally come to be considered as a mean effective pressure referred to a b.hp. that is safe. If a mean effective pressure is selected not so low as to impair the fuel economy, nor so high that there is danger of trouble from excessive heat, there should be no trouble in pulling 25 per cent overload at sea level for short periods. If the engine is rated too high, it is more susceptible to factors which may affect its power output. Some of these conditions are:

1. Variable quality of fuel.
2. Load unequally divided among the cylinders.
3. Failure to keep atomizers, fuel pumps, and parts in good running order.
4. Worn piston rings.
5. Cooling-water difficulties.
6. Improper adjustments.

Good Grade of Fuel Oil Essential

As good a grade of fuel oil as it is possible to get should be used in any Diesel engine. This does not necessarily mean a light oil, as heavier grades are more economical; it has reference mainly to the objectionable impurities, which may attack the metal with which the oil comes in contact, impair the lubrication, or cause deposits within the cylinder. In all of these cases it is assumed that the oil is sufficiently atomized to produce complete combustion in the presence of a sufficient supply of clean air. Coarse sand and water can be extracted by a filter. Such impurities as sulphur, ash, coke, and asphaltum can be handled in moderate quantities, but if a fuel is allowed to stand unagitated, strata of various grades of fuel will form, which will not act uniformly in the engine. If a stratum is used that is difficult to burn and causes late combustion, the power of the engine will be reduced. The heat units supplied to the engine will not be entirely converted into work, and more heat will be developed within the engine, resulting in a condition analogous to overload.

Unequal Distribution of Load Common Cause of Trouble

Probably the most common difficulty encountered is caused by the unequal distribution of load among the several cylinders. This is purely an operating difficulty, but as an engine may run for long periods with abnormal loads on some of the cylinders, it is very serious if the rating is too high.

A well-constructed atomizer needs little attention, but even with good care there is a possibility of a leaky valve or trouble with the flame plate. In either case, combustion will be rendered less perfect, and a consequent drop in the governor will throw a greater load on the remaining cylinders. Similarly, a fuel pump that does not function properly causes the load to be shifted from the cylinder which it serves to the others, and loads them abnormally. Worn piston rings are another common defect, but these can be detected from the outside.

Bad Cooling Water Should Be Purified

In mining districts, untreated mine water, high in scale-forming matter, is commonly used for cooling Diesel engine jackets. Such water would not be considered for use in a boiler. Although no similar water temperatures are reached as exist there, the surfaces with which the water comes in contact are extremely

hot. Along the upper part of the liner or cylinder head, local boiling may be going on, and there scale may be deposited. Such scale accumulation, especially in the piston water space, causes carbonization of the lubricating oil, followed either by piston-ring leakage or friction, which results in an added load on the engine.

Improper adjustments are not as unusual as they should be, and ratings of the engine should be liberal enough to guard against trouble arising from this source. This can be done only in a measure, to be sure. No formula takes into account the human element, so that even if the rating of the engine is liberal, compensation cannot always be made for this fault.

Skilled Operators Required

Any or all of the above causes may create sufficient difficulty to give the impression that the Diesel engine is troublesome and unsatisfactory. Conservative rating will exclude all trouble arising from the causes as given. Such minor difficulties would, however, not cause serious results even where units are rated high, provided a skilled operator were in charge. It is unfortunate that more such operators are not available, for all that a well-designed unit needs (and this means an engine built by a concern with a long Diesel experience), is the attention of a careful and intelligent operator, systematic inspection, and immediate attention to parts that show weakness.

Direct-Connected Compressors Adapted to Mining Work

Fig. 3 shows a plant in which four 1,250-hp. units are running. At the farther end of the power plant, and hidden behind the last unit, is a compressor direct-connected to a Diesel engine, which is interesting, as it is a development growing directly out of the mining

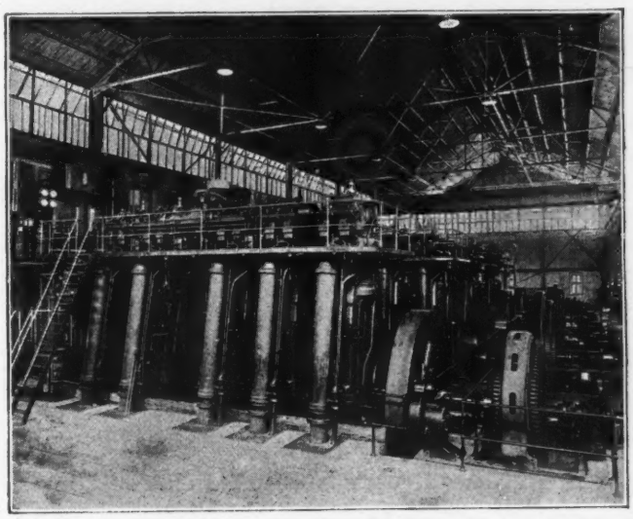


FIG. 3. A 5,000-HP. DIESEL ENGINE INSTALLATION

industry. The capacity of the compressor is entirely dependent upon the speed of the engine, as no variable-capacity devices are employed. In mining work, it is seldom that no air at all is required.

Stopping or starting even a large Diesel engine is not nearly as difficult as in the case of a steam plant, and can be done in much less time, so that if periods are encountered, even several times a day, where no air at all is necessary, the unit can be shut down. Such units are now built to vary between 70 and 180 r.p.m., which seems to be sufficient speed variation to suit the demand for air. The Diesel engine of this type, as should be remembered, must accomplish the same amount of work per stroke, whether running full speed or one-third speed, the requirements differing materially from those of the marine types, where the torque varies approximately as the square of the speed. The importance of uniformity of torque is immediately apparent, and the reason for the adoption of the two-cycle engine for this class of work is also clear.

The higher speed of 180 r.p.m. excludes the use of eccentric-driven valve gear on the compressor, so that a special feather valve was constructed, which has been entirely satisfactory. The capacity of the blast air compressor, which is direct-connected to the engine as shown in Fig. 2, determines the minimum speed of the unit. By supplying an additional amount of blast air the speed has been reduced to 56 r.p.m., when the exhaust just began to be visible. Inasmuch as the quantity of blast air varies with the speed, a special governor was designed which makes the engine entirely automatic.

The dimensions of the scavenging pump are the same as for a constant-speed engine, no changes whatever being made in the setting of the scavenging valves. The scavenging pressure varies from about 4 lb. per sq.in. at full speed to about 2 lb. per sq.in. at 70 r.p.m. The pressure of the compressed air also varies as the speed, dropping to a minimum of 330 lb. per sq. in. at 60 r.p.m., at which time the exhaust is invisible, and as even and regular as at full speed. These observations were made on a three-cylinder engine direct-connected to a 4,000-cu.ft. compressor.

Construction of the Governor

The governor employed for the regulation of the unit is a combination of an extremely static governor and an air plunger in communication with the receiver in the discharge line. The air plunger is frictionless, and is loaded by means of weights. In addition, a light spring is used to give a continually increasing load as the plunger is pushed out of its cylinder. This plunger is connected to the fuel-pump mechanism, so that, as it emerges, it decreases the fuel supply to the cylinder of the engine. As the static governor rises, it produces the same result.

In a well-designed Diesel engine driven compressor, the amount of fuel consumed is the same per stroke whether running at high or low speed, so that the mechanism controlling the fuel supply remains in practically a fixed position for all speeds. If the air pressure should drop, the air plunger will descend, giving more fuel to the engine, which immediately picks up speed. The speed governor then rises and cuts down the fuel until the speed is adjusted to correspond to the original fuel consumption. A constant pressure can be maintained with this type of governor with all variations in the rate of air consumption.

One Pound of Fuel Required To Compress 1,000 Cu.Ft. of Air

A fuel consumption of slightly less than 1 lb. per 1,000 cu.ft. of free air compressed to 80 lb. per sq.in. has been realized during a test made on the 4,000-cu.ft. compressor described. This unit, as mentioned, is running at an elevation of 5,950 ft. It is interesting to note that the work of compressing 4,000 cu.ft. of air

is less at this elevation than at sea level. The fuel consumption is, however, slightly increased, so that the net result is an approximately constant fuel consumption of 1 lb. per 1,000 cu.ft. of free air. A commercial run covering thirty consecutive days of sixteen hours a day showed a consumption of 1,095 lb. per 1,000 cu.ft. compressed to 80 lb. per sq.in., which includes all the fuel oil used for starting, filling tanks, and leakage.

The compressor has a valve attached to the discharge pipe, which is open during the starting of the engine so that no air is compressed, and closed as soon as the engine is up to speed. The air compressed is determined from the counter reading. An elaborate test was made to determine the volumetric efficiency of the compressor, the weight of air being calculated both from indicator cards and from the flow through a fixed nozzle. In this way a factor was determined, which, if multiplied by the number of revolutions, would give the actual quantity of free air compressed.

Comparison of Diesel Engine With Steam Plant

In a comparison of the efficiency of a Diesel engine with that of a well-designed steam plant, probably no better illustration can be found than the results from two compressor plants, one operating with steam and the other with a Diesel engine. A very economical steam compressor plant built for the Champion Copper Co. was tested by Professor O. P. Hood, and the work described in the Transactions of the American Society of Mechanical Engineers, Vol. 28, p. 221. The Champion Copper Co.'s compressor has held the world's record for economy, despite the fact that conditions at the plant were unfavorable, as it was impossible to carry any superheat or the specified boiler pressure. The test showed an extremely good thermal efficiency. The steam pressure at the throttle valve was 243 lb. per sq.in., which was the basis for the determination of the number of B.t.u. delivered to the engine. The steam was very wet. The work delivered per million B.t.u. supplied was 194,930,000 ft.-lb.

Herewith are presented data taken from a test made on the air compressor plant built for the Phelps Dodge Corporation at the Burro Mountain Copper Co., Tyrone, N. M.:

AIR COMPRESSOR TEST

3 EG Diesel engine.
750 b.hp. sea-level rating, direct-connected to a compressor.
Size of air cylinders, 19 and 33½ x 24.
Duration of test, 5 hours.
Total fuel consumed, 924 lb.
Total number of revolutions, 41,520.
M.E.P. referred to L.P. cylinder, 29 lb. per sq.in.
Average r.p.m., 138.6.
Maximum rated r.p.m., 180.
Work per revolution, 101,500 ft.-lb.
Fuel, per revolution, 0.022 lb.
Fuel temperature, 130°F.
Average air pressure, 88 lb. per sq.in.
Quality of fuel used, 19 Bé.
B.t.u. content per lb., 19,100.
Duty for every million B.t.u. supplied, engine delivered 238,500,000 ft.-lb. of work, based on i.h.p. of air cylinder.

In the steam plant it must be remembered that the heat units are measured at the throttle, and the boiler-room and steam-pipe losses are not taken into account. Assuming these to be 20 per cent, the 195,000,000 ft.-lb. of work per million B.t.u. supplied dwindles down to about 156,000,000. In the Diesel plant, the duty given is based on the actual fuel delivered to the engine and the amount of work measured in the cylinders. The relative over-all efficiency can easily be seen from these figures.

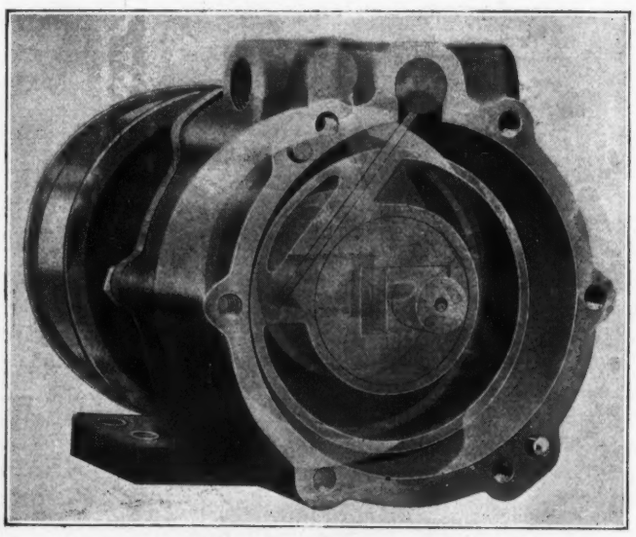
To such an installation the Diesel engine is particularly well adapted. With a constant load to pull at all times, its rating can be made such as to be perfectly safe. No means of overloading it are available, so the factors mentioned earlier in this paper which affect the load-carrying capacity of the engine are not likely to cause trouble.

The speed of the compressor continually varies to suit the demand, which makes the average speed low, an advantage which cannot be overestimated. The amount of fuel burned per stroke is a constant and allows an adjustment of the supply of cooling water to be made which need not be changed and which reduces the possibility of overheating the jackets. Little attention need be given to the unit, as the necessity of supplying automatic devices to hold the blast-air pressure constant obviates part of the care necessary in ordinary Diesel plants.

A similar compressor is now being installed in the plant mentioned, the capacity of which is 6,400 cu.ft. of free air per minute, direct-connected to a five-cylinder engine. Further tests on this compressor will soon be made, and though it may not be possible to reduce the fuel consumption, there are other features which may be of interest and which can be discussed at some later time.

A New Pump With a Rolling Impeller

The construction of a new pump placed on the market by the Michigan Machine Co., of Detroit, Mich., under the name of the "Rollway" pump is shown in the accompanying photograph. Its principal working parts consist of two rollers which rotate eccentrically in the pump chamber. A spring is placed in the rectangular slot in the inner roller, which bears against the squared shaft,



INTERIOR CONSTRUCTION OF THE "ROLLWAY" PUMP

and which operates only when the pressure on the pump is as great as the pressure required to compress the spring. When this pressure is reached, the compression of the spring allows the rollers to come to the center of the pump, where they continue to revolve in the liquid without doing any pumping.

The "Rollway" pump is a positive one, but is also self-priming, and may be used within 10 ft. of the level of the liquid to be handled. Foreign matter will not clog it. The pump may be economically operated at speeds ranging from 100 to 600 r.p.m.

Geology of the Gogebic Range and Its Relation To Recent Mining Developments—Part II*

Contact Between the Two General Subdivisions of the Iron-Bearing Formation Is Well Defined—Members Composing Main Divisions Possess Distinguishing Characteristics and Can Usually Be Recognized, Although Contacts Are Gradual

BY W. O. HOTCHKISS
State Geologist and Consulting Engineer, Madison, Wis.

WHEREVER exposed, either in mine workings or in drilling, the Ironwood formation is found to be made up of two major subdivisions. The contact between the two is always a sharp transition from a wavy-bedded ferruginous chert formation to an even-bedded, more or less heavily ferruginous slate. This contact differs from many of the other contacts between the chert and slate formations in that it is abrupt. In many cases the other contacts between the ferruginous slates and ferruginous cherts are marked by a gradual change, in which material of one character increases through a thickness of a few inches to several feet, whereas the other material decreases. The relations of these two major parts of the Ironwood formation are given in detail in the discussion of the Norrie member. For convenience of reference to these two portions of the formation the name Lower Ironwood is suggested for the basal part and Upper Ironwood for the upper part. These two portions of the iron formation correspond to what in the past have been called tentatively "South Belt" and "North Belt" in some of the work on the western end of the range.

Each of the main subdivisions of the Ironwood formation is made up of distinct members which can be recognized throughout the range wherever exposed in mine workings. The subdivisions of the Ironwood formation and the base of the overlying Tyler are as follows:

Tyler Formation	Graywacke slates. Iron carbonate slates. Pabst member, cherty and fragmental and ferruginous slate beds.
Upper Ironwood Formation	Anvil ferruginous chert member. Pence ferruginous slate member.
Lower Ironwood Formation	Norrie ferruginous chert member. Yale member—interbedded ferruginous cherts and ferruginous slates. Plymouth ferruginous chert member.

Names have been given to the various members of the iron formation and the basal member of the Tyler to facilitate easy reference in discussing them. It is believed that the use of the names of prominent mines of the district for this purpose will be the most acceptable that could be suggested. The names used were selected with the purpose of showing mines where the particular member is well developed, but this was not always feasible, because the names of many of the mines are already in use as formation names in other localities.

The various members are distinguished by the characteristics described in the discussion of the difference between the beds. Three members—the Plymouth, Norrie, and Anvil—are dominantly wavy-bedded granular or fine-grained ferruginous cherts; the Yale and Pence, which separate these three, are dominantly even-bedded ferruginous slates. In distinguishing these members in the mines it is not always easy to determine with engineering accuracy where the contact should be drawn. Many of the contacts are gradational zones, and any bed in these zones can be taken as the contact. Usually, however, there is little difficulty in identifying the contact within a few feet.

A reference to Fig. 17 will indicate the thickness of these members in various parts of the range. The numbered lines represent cross-sections along which the thicknesses of the various members have been measured horizontally, regardless of the inclination of the beds. In denoting the measurements it was thought best to depart from the usual custom of giving actual thickness of beds, and to adopt a method which is more convenient for the mining engineer, because of the fact that mine workings are on horizontal planes. The straight line from which the numbered cross-section lines extend is used to represent the base of the iron formation. Most of the sections measured were in crosscuts extending north from the foot wall. Such of them as are based on diamond-drill data have been reduced to the same system of measurement.

As the change in dip in the various parts of the range is comparatively slight, the sections shown in Fig. 17 will give comparative ideas of thickness of the beds. If actual thickness is desired, the distance given in the figure can be multiplied by the proper factor, assuming that the dip averages 60 degrees.

These various sections were taken as follows: (1) West side of Penokee Gap; (2) Tyler's Fork; (3) Atlantic mine approximately at No. 3 shaft, based on diamond-drill data; (4) Plumer shaft, 5 level crosscut; (5) Pence No. 2 shaft and diamond-drill hole; (6) Montreal No. 29 crosscut, 23 level; (7) Montreal No. 4 shaft, crosscut, 20 level; (8) Montreal No. 4 shaft, 8 level diamond-drill hole; (9) Ottawa 10 level, shaft crosscut; (10) Ottawa 14 level, crosscut near east end of mine; (11) Cary 19 level, No. 16 crosscut; (12) Windsor 8 level, No. 1 crosscut; (13) Ashland mine, 13 level, No. 9 shaft crosscut; (14) Norrie, combined from 14 and 17 levels, "A" shaft crosscuts; (15) Aurora 13 level, "E" shaft crosscut; (17) Davis 4 level, shaft crosscut; (18) Geneva 17 level, crosscut 350 ft. east of shaft; (19) Puritan 14 level, shaft crosscut; (20) Ironton crosscut 500 ft. east, on 17 level; (21) Ironton crosscut 1,860 ft. east, on 17 level; (22) Yale No. 1 shaft crosscut, 11 level; (23) Colby 9 level, No. 2 shaft crosscut; (24) Tilden 9 level, No. 6 shaft crosscut; (25) Tilden 23 level, No. 10 shaft, crosscut 1,250 ft. west of shaft; (26) Tilden 14 level No. 10 shaft, crosscut 180

*Part I was published in the *Journal* of Sept. 13, 1919.

ft. east of shaft; (28) Eureka 15 level, No. 2 shaft crosscut, and (29) Mikado, mostly from diamond-drill footwall.

The Plymouth member of the iron formation is of particular interest because it is the one from which has come most of the iron ore mined on the Gogebic Range. In character it is predominantly a granular ferruginous chert, with some fine-grained chert beds. It is made up of a number of different beds, which bed of the Ironwood formation. Its contact with the quartzite below is abrupt, and is noticeably irregular in such a manner as to indicate conclusively that an erosion period intervened between the deposition of the quartzite which forms the foot wall and the deposition of the Ironwood formation. The character of this thin introductory bed varies from quartzite in which the chert is present only as the filling of the spaces between the sand grains to a clear fine-grained chert in which there are only a few quartz grains. In mine maps this

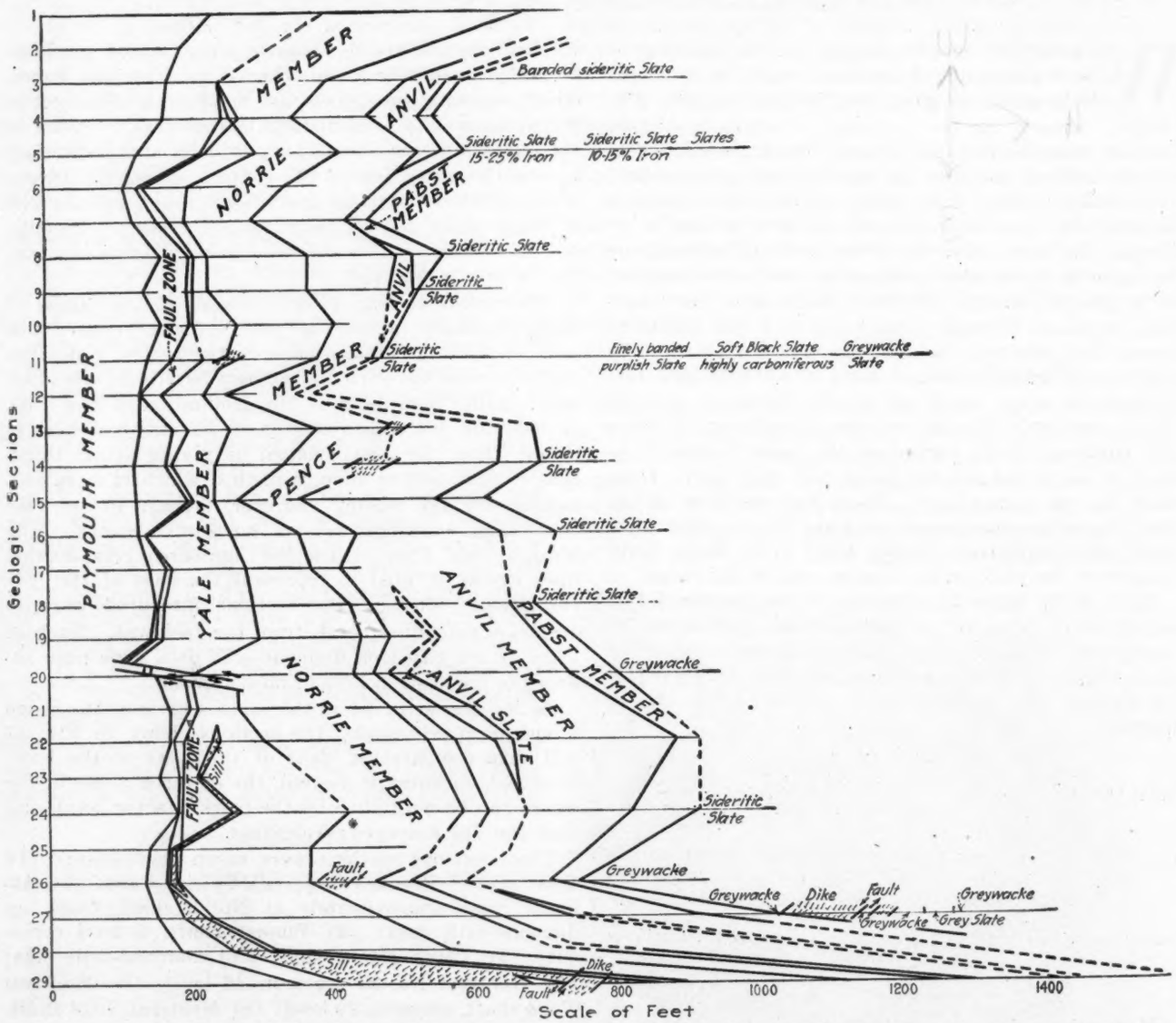


FIG. 17. TWENTY-NINE MEASURED GEOLOGIC SECTIONS ILLUSTRATING THE CORRELATION AND CHANGES IN THICKNESS OF THE VARIOUS MEMBERS OF THE IRONWOOD FORMATION

The line at the left represents the base of the formation. The top section is the westernmost, at Penokee Gap, and the lowest one in the figure is farthest east, in the Mikado mine.

could doubtless be mapped if sufficient time were given to the study.

The lowest part of the member is a thin cherty quartzite, which is sometimes present at the base. It is occasionally as thick as five feet, and rarely reaches a thickness of ten feet. Like the true foot-wall quartzite, it is chiefly composed of rounded sand grains, but it differs in being cemented with chert, rather than with the crystalline silica, which is the characteristic cement in the true Palms quartzite foot wall. Wherever it is present, this cherty quartzite makes the southernmost bed, where present, is always included with the main quartzite as a part of the foot wall.

Succeeding this cherty quartzite bed, or, in the absence of the cherty quartzite, lying directly upon the Palms quartzite, is a gnarled concretionary jasper and jasper conglomerate. This bed is present in all places where the foot wall of the formation is seen. In some cases the conglomerate nature is strongly evident and in other places almost lacking. Sometimes the red color, a characteristic of jasper, is lacking, and the bed is light gray or greenish gray in color. Frequently in the

mines, and particularly in the vicinity of orebodies, its distinctive characters are almost wholly lost because of the extensive alteration. This bed is from one to four or five feet in thickness throughout the central portion of the range from the Plumer mine to the Eureka. At Penokee Gap it becomes eight or ten feet in thickness, and at the Mikado mine its thickness increases to forty feet. What is believed by some to be the equivalent of this same jasper in the mines to the east of the great Sunday Lake fault attains a thickness of over 100 ft. Other observers believe this 100 ft. of ferruginous chert to be the equivalent of the whole Plymouth member. I am inclined to agree with the latter, but I should hesitate to state my views positively, because of my meager acquaintance with the formation east of the great Sunday Lake fault.

"Foot-Wall Slate" Shows Considerable Oxidation

Succeeding the gnarled conglomerate jasper above described there is present almost everywhere in the lower part of the Plymouth member what is known as the "foot-wall slate." This is a heavily ferruginous slate in most places, and usually, where seen in the mines, is thoroughly oxidized so that it is red in color and soft in character. In common with the jasper below it, this slate increases in thickness in the east and west sections shown in Fig. 17. At Tyler's Fork there are ten feet of this slate, with nearly twenty feet of a gradational zone between it and the granular chert beds above. In the Mikado mine it is nearly thirty feet in thickness. On the 23 level of the Brotherton shaft there are two feet of slate about twenty feet north of the quartzite which may be correlated with the "foot-wall slate" in the mines west of the Sunday Lake fault. In most of the mines the slate has a maximum thickness of only two or three feet, and in some cases it becomes so thin that it practically disappears. In almost all cases, however, a thin soft seam is present, which can be correlated with the foot-wall slate.

Above the foot-wall slate appears the main granular ferruginous chert of the Plymouth member. These granular chert beds are excellently shown at Tyler's Fork and at Penokee Gap, in natural exposures, and at the Plymouth and Wakefield open pits, where the mine excavations give an opportunity to view this member. The individual beds vary in thickness from a small fraction of an inch to three or four feet. Alternating with the chert beds are beds of iron oxide of varying thickness, seldom more than an inch, but in a few cases reaching a foot. The iron content of these chert beds is largely in the hematite beds just mentioned. In the chert beds themselves, granules of hematite and minute crystals of magnetite are sometimes so abundant as to make up the major portion of the bed. However, much of the iron is present in the thin layers or beds between the beds of granular ferruginous chert. From this statement it is to be observed that where the bedding is thick, and these bedding planes are far apart, the iron content is likely to be considerably lower than in those where the bedding planes are close together and beds are thin.

Certain rather consistent general tendencies as to thickness of bedding characterize various parts of this granular chert portion of the Plymouth member. The lower part of it, for distances varying from twenty to sixty feet from the foot-wall slates, is frequently characterized by beds one to five or six inches in thickness, with rather heavy beds of iron oxide separating them. North of this in many sections there is observed a tendency on the part of the chert beds to become much thicker and more massive, and the separating beds of iron oxide to become thinner. This massive phase of the chert is frequently also fine-grained chert, rather than the distinctly granular variety. The thickness of this massive chert is exceedingly variable. In some cases the chert is entirely lacking, and again it has a thickness of fifty or sixty feet. Above it to the north usually occurs the thinnest bedded portion of the wavy-bedded cherts of the Plymouth member. In this portion the chert bands are seldom more than an inch, and oftentimes less than a quarter of an inch, in thickness, and the beds of iron oxide separating the chert beds are approximately of the same general thickness. This thin-bedded portion usually constitutes the uppermost part of the Plymouth member, but in some cases toward the top the chert beds again become thicker.

Near the top of the Plymouth member from the Davis mine west, either just at the top or within ten or twenty feet of it, there is a rather striking bed of yellow flinty chert which is more or less conglomeratic.

East of the Davis mine in approximately the same part of the Plymouth member there is found a thin horizon containing thin beds of brilliant red jasper, which also is somewhat conglomeratic. This yellow flint bed at the west end and the jasper bed at the east end are probably equivalent beds. In no places were the two found together. This striking distinction of color and flinty character in a member which contains practically no other flinty chert beds makes them particularly valuable as horizon markers.

In the Penokee Gap and Tyler's Fork exposures a short distance above the foot-wall slates some thin beds of granular red jasper are found, usually two or three inches in thickness, but occasionally reaching a thickness of a foot or more. West of the Davis mine these red jasper beds and the bed below the foot-wall slate are the only occurrences of red jasper seen in the Plymouth member. East of the Davis mine, however, the granular ferruginous chert of this member shows a fairly large amount of red granular jasper. The red granular jasper differs from the granular chert in character only in the fact that the individual grains are in large part jasper grains. This increase of granular red jasper toward the eastern end of the range is characteristic of all members of the Ironwood formation.

The transition to the Yale member is marked by a rather abrupt gradation from the fine-grained chert (which often succeeds the yellow flinty chert) to a ferruginous slate. The gradation beds are usually less than one foot in thickness.

The Yale Member

In the Yale member are grouped a number of beds of even-bedded ferruginous slate and wavy-bedded ferruginous chert, each of which is distinct from the adjacent beds, and which occupy the middle part of the Lower Ironwood formation. The base of the Yale is taken as the base of the first ferruginous slate, lying from 100 to 350 ft. north of the foot wall, as shown in Fig. 17. The top is less definite, but is taken as the top of the slate bed 60 to 150 ft. north of the base of the member in the western and central parts of the district, but at a much greater distance north at the eastern end of the range.

Closer study would almost certainly result in dividing the Yale member into several separate members. The best that could be done in the short time available for study of the Michigan end of the range was to group and name as a single member these slates and the included chert beds which lie between the Norrie and Plymouth members. In Wisconsin, where a more detailed study has been made, three slate beds can be traced definitely throughout the various mines and the various levels of each mine, with no considerable difficulty excepting where the great bedding fault has pinched one of them out. These separate slate beds are relatively thin, and vary individually from only three or four feet to thirty or forty feet in thickness. It is entirely possible that they represent discontinuous lenses which cannot be followed throughout the whole range, but it is believed most probable that some of the thicker ferruginous slates represent general conditions sufficiently that a careful study would show them to be continuous from one end of the range to the other. This, however, remains for more extended work to prove or disprove. Whether continuous beds or discontinuous lenses, they are sufficiently abundant to make the Yale member dominantly a ferruginous slate.

By referring to Fig. 17, it will be noted that the great bedding fault lies almost entirely within the Yale member. In some cases, as in Sections 3 and 4, the bedding fault lies in the extreme top of the Yale member and extends even into the cherty Norrie member above it. In Sections 12, 18, 19, 22, and 24, it will be noted that the great bedding fault lies along the lower side of the Yale member. For the major portion of the length of the range, however, this fault follows one of the thickest and best-developed of the ferruginous slate beds in the Yale member, the middle one of the three ferruginous slates of the Yale in Wisconsin. This is a finely laminated ferruginous slate, which, in its less altered form, is a black, slaty iron carbonate, containing so much fine, disseminated, black carbon as to have a graphitic appearance in many places. In its altered form this black slate is no longer black, but is stained red by the iron oxide, exactly as are the other ferruginous slates in this member. Usually, however, its more finely laminated character offers a fairly satisfactory means for distinguishing it.

Absence of Carbon in Slate Beds

In no case were the other slate beds in the Yale member observed to contain carbon or to have a black appearance similar to the slate previously described. In their original form they are likely to be rather pure; gray, slaty iron carbonate, either free from or having moderate amounts of thin-bedded flinty chert. The oxidized phases are soft and red and not so thinly bedded as the black slate above described.

West of Section 17 in Fig. 17 the upper slate bed of the Yale member is generally free from chert. In the Davis mine and eastward the top of the Yale member is taken as the north side of a thinly and evenly bedded part of the formation which is marked by ⅛-in. to ¼-in. flinty chert bands, separated by about equal thicknesses of hematite. This part of the formation is described as "platy" in character, because of the thin, even, continuous beds of flinty chert. My observations have not gone far enough to make sure as to whether these platy beds really belong with the slates of the Yale member, or whether, because of their great chert content, they should be included with the Norrie ferruginous chert. On account of their even-bedded character, which is in marked contrast with the decidedly wavy beds of the Norrie, it has seemed best to include them in the Yale member.

The ferruginous chert beds which lie between the ferruginous slates in the Yale member are diverse in character. Throughout most of the district they are largely of the fine-grained wavy-bedded type, and either dull brown or a pale greenish gray in color. East of the Davis mine these ferruginous chert beds, like all the rest, begin to show increased amounts of red granular jasper, sometimes in scattered grains in ordinary granular chert and sometimes making up the whole of an individual layer.

In some parts of the ferruginous slates of the Yale member flinty cherts are found. These are particularly characteristic of the transition stages from the ferruginous slates to the ferruginous cherts. The transition zone at the top of the black slate is frequently characterized by a number of one-half-inch to two-inch beds of clear, glassy black flint. Most of the ferruginous chert beds in the Yale member are characteristically low in iron content, and the individual beds are likely to be rather thick. Some of them have a thickness of as much as four or five feet. This is mostly the case with the brown and green fine-grained cherts.

The transition from the southernmost slate of the Yale member to the Plymouth member is usually somewhat abrupt. In some cases, however, it is apparently gradational in character. The transition from the upper slate in the west and the platy flint in the east to the Norrie member is almost always gradational. The possibility is suggested that the Yale member may be separated from the Plymouth member by an interval of moderate erosion. On this possibility, however, little evidence has been accumulated. The relation of the Yale member to the Norrie member is such as to suggest continuous deposition and an entirely conformable relation.

The thickness of the Yale member measured horizontally varies from about 65 ft. in the Ottawa mine, as shown in Section 8 of Fig. 17, to 370 ft. in the Eureka mine, as shown in Section 28 of the same figure. To a large extent this increase in thickness is due to increased thickness of the platy flint beds.

The Norrie Member

The Norrie member is made up almost wholly of wavy-bedded granular and fine-grained ferruginous chert, with hematite in beds and grains exactly as in the Plymouth member. The thickness of the individual beds varies considerably from place to place in this member, but there is in general in the lower part of the Norrie a heavily ferruginous, moderately thin-bedded part, succeeded by rather massive, thick-bedded, fine-grained chert, which has low iron content. In most places where it is known, the upper part of the Norrie member is thin, wavy-bedded, heavily ferruginous chert. In places where the Norrie member is thicker than usual there is oftentimes found at the very top a massive, thick-bedded, fine-grained, green chert, which alters in spotted fashion, giving an appearance which has been described as "worm-eaten chert." These leached spots are usually a quarter to an eighth of an inch in diameter.

East of the Davis mine the thin-bedded upper part of

the Norrie contains numerous thin beds of ferruginous slate, which vary from a few inches to one foot or two feet in thickness. The thickness of the Norrie member is as little as 30 ft. in the Windsor mine and becomes as great as 230 ft. in the Yale mine. Fig. 17 shows that the Norrie member varies greatly in thickness in short distances. In some of the crosscuts across the formation the Pence member apparently cuts out the upper beds of the Norrie member, leaving only a few feet of the lower portion.

Marking the top of the Norrie member in a pronounced fashion in the western end of the district, but somewhat less noticeable in the eastern part, is a thin conglomerate made up of flat pebbles of a considerable variety of phases of the iron-formation material. Associated with this conglomerate bed is often found several inches of granular red jasper having a decidedly fragmental appearance. This granular jasper, rather than conglomerate, is the usual phase found east of the Ashland mine.

The considerable variation in thickness of the Norrie, the difference in the character of its uppermost beds, where it is thick, from those which make the top, where it is thin; the abrupt transition in character of beds from Norrie to Pence, and the occurrence of a conglomerate or of a fragmental appearing granular jasper, are all facts which indicate an erosion interval succeeding the deposition of the Norrie and preceding the deposition of the Pence. Though little can be said of the duration of this period, it was probably relatively short compared to the erosion period between the granite and the Palms, or that between the Anvil and the Pabst members.

THE PENCE MEMBER

The Pence member is an even-bedded, thin-bedded ferruginous slate. Practically wherever seen the transition is abrupt from the wavy-bedded ferruginous cherts of the Norrie member, with its beds oftentimes as much as three or four inches in thickness, to the strikingly even-bedded, very thin-bedded Pence member. The conglomerate which marks this transition has been discussed under the Norrie member. West of the state line, where the Pence member is thickest, at the top of the Pence there is a gradation upward into a massive, brown, fine-grained, ferruginous chert, which is sometimes twenty or thirty feet in thickness, but, even though this brown chert is rather thick bedded, the bedding planes show a striking parallelism.

In some parts of the range, more particularly the eastern, the Pence member was apparently, in its original condition, a fairly pure iron carbonate rock with comparatively little magnetite or hematite present excepting in a few localities. In the Wisconsin part of the range, however, are numerous localities where this slate, as seen in its unaltered condition, is to a large extent made up of grains of hard blue hematite with a fair proportion of magnetite.

The chert present in the Pence member seems to vary considerably in moderately short distances. In some parts of a single mine this member is comparatively free from chert, and in other parts certain portions of the member will show an abundance of thin, continuous, flinty chert plates an eighth to a quarter of an inch in thickness. These flinty chert plates or bands are usually of a clear greenish gray or light yellowish gray in color. Where the formation is altered to any extent, these clear flint bands easily disintegrate into a white chalky chert, which can be crumbled in the fingers like a soft blackboard crayon. Certain beds of this chalky chert make excellent markers for identifying horizons and are especially useful when working out a faulted condition. In the mines on the Wisconsin end of the range, where this member is thickest, about 60 to 80 ft. from the base of the member there is a horizon frequently marked by a number of thin bands of red jasper, which also serve to identify this part of the formation.

Fig. 17 shows that on the western end of the range, the base of the Pence member is found at distances from the quartzite varying from 260 to 400 ft. In the Norrie, Aurora, and Pabst mines it is 300 to 400 ft. from the foot wall, and is known as the "350-ft. slate." In the Yale mine, Section 22 of Fig. 17, it lies 550 ft. from the quartzite, and is called the "550-ft. slate." By tracing the Pence member between these two points it is found that the "350-ft. slate" of the Norrie is the same as the "550-ft. slate" of the Yale, and the "550-ft. slate" of the Norrie is the same as that which lies nearly 900 ft. north of the quartzite foot wall in the Yale.

On the Wisconsin end of the range, the Pence member varies from 80 to 130 ft. in thickness. This thickness continues fairly uniform eastward to the Davis mine, where there is a rather sharp decrease to a thickness of twenty-five to forty feet. All through the eastern end of the range the member will average close to thirty feet in thickness. The top of this member grades within a comparatively small thickness of beds into the granular jasper and granular chert of the lower part of the Anvil member. The Pence member in many localities contains sufficient magnetite to give a magnetic line when tested with the dip needle.

THE ANVIL MEMBER

The lower part of the Anvil member is everywhere composed of wavy-bedded granular chert and granular jasper, with frequent conglomeratic beds. The upper part of the Anvil is much less granular and conglomeratic, and contains more wavy-bedded flinty and fine-grained chert. This member is like the other chert members of the Ironwood formation in that granular jasper is more abundant toward the eastern end of the range. Toward the western end of the range the proportion of granular chert increases and the jasper is relatively insignificant in amount. On referring to Fig. 17 it will be noted that this formation is present in Sections 3, 4, and 5 and is missing in Section 7; is again present in Sections 8 and 9, and then does not appear again until Section 13 is reached, from which point it is continuous to the Mikado mine and probably beyond that to the great Sunday Lake fault, which offsets the formation east of the Wakefield and Mikado mines.

In the western end of the district the maximum thickness shown is in Section 4, where it attains seventy feet. It reaches a maximum thickness of about 300 ft. in the eastern portion of the district around Sections 20 to 22. Farther east, in the Mikado mine, its total thickness was not penetrated in the drill hole from which the section was made. In Sections 18 to 22, 27, and 29 there appears a lens of slate (called the Anvil slate in Fig. 17), which is exactly similar in character to the Pence member in the same sections. Above this slate the formation is almost invariably possessed of a high iron content and of a porous character which makes it a favorable place for that extreme alteration

of the formation which results in orebodies. It is in this member that many of the large "hanging-wall" orebodies have been found in the last few years.

THE PABST MEMBER OF THE TYLER FORMATION

The transition of the Anvil member to the overlying Pabst member is almost invariably an abrupt one. In the eastern end of the range, where the Anvil member is thickest, it is usually followed by a thin carbonate slate, but in the western portion, where the formation has nearly all been eroded away, the transition is usually marked by the beginning of conglomerate and the granular jasper associated with it.

The Pabst member can hardly be defined with accuracy, because of the scarcity of information concerning it. It is known in few places except in diamond-drill holes, and whether it should include the whole of the heavily ferruginous basal portion of the Tyler formation, or be limited to the dominantly cherty portions of this, it is difficult to determine. As drawn in the sections of Fig. 17, it includes only the dominantly cherty parts of the lower portion of the Tyler formation. The slates above this, in some cases for 300 ft., carry considerable percentages of iron in the form of iron carbonate, and probably when sufficient information becomes available should be given a definite name.

The relations of the Pabst member to the formations below are unconformable, and indicate an erosion interval between the deposition of the Anvil member and the beginning of the deposition of the Pabst member that probably was of considerable duration. This is shown by the fact that the Pabst member cuts across and covers at least two relatively small residual areas of the Anvil formation which are entirely separated from the main portion of this formation on the east—indicating that the Anvil member was entirely eroded in places—and also by the universal presence of conglomerates and coarse fragmental deposits in the Pabst member.

From the Norrie mine east the introductory bed of the Pabst member is a thin-bedded, somewhat slaty iron carbonate, which varies from a few feet in thickness up to thirty feet or more. Succeeding this there is usually a bed varying from a few feet up to thirty or forty feet in thickness, which is obviously conglomeratic and fragmental in its nature. This bed varies decidedly in character. In some places it is made up almost entirely of irregular and rounded fragments of iron oxide and is rich enough to be mined for ore. This is called the "fragmental ore horizon" in many of the mines. In other occurrences it is made up almost entirely of fragments of chert and slate, and in still other places it is chiefly fragmental granular jasper. In all its occurrences it is highly variable in character and likely to be interspersed with thin, slaty, flinty, iron carbonate lenses or even impure quartzite lenses. In some places these impure quartzite lenses attain a thickness of thirty of forty feet. One section of the Pabst member, measured in the Tilden mine, is given in detail as follows, beginning at the base and measuring northward:

0 to 22 ft., dense hard ferruginous slate, thinly bedded and evenly banded, and showing much magnetite in tiny crystals scattered throughout the rock.

22 to 37 ft., conglomeratic red granular jasper, with a matrix of hard, red and blue hematite.

37 to 41 ft., granular jasper and red, coarsely crystalline iron carbonate.

41 to 46 ft., mixture of alternating thin bands of impure quartzite, fine-grained massive iron carbonate and granular jasper.

46 to 51 ft., dense, hard, amorphous, greenish-gray iron carbonate.

51 to 52 ft., conglomerate of flat flint pebbles in a matrix of chert and hematite.

52 to 63 ft., dense brown flint, evenly and thickly banded, and amorphous unoxidized iron carbonate. Top of Pabst member.

63 to 67 ft., black iron carbonate slate, very evenly and thinly bedded, and moderately hard.

The foregoing section gives a good picture of the rapidly alternating conditions under which the Pabst beds were deposited. The only places on the west end of the range where the introductory slaty iron carbonate bed of the Pabst has been found are in a drill hole a short distance west of the Pence shaft and in one crosscut in the Plumer mine. The section from the Tilden mine described above shows an assorted condition of the materials which is much better than is characteristic farther to the west. In the west the Pabst beds are usually a mixture of all of the materials which have been separated into more or less distinct beds in the Tilden section. The Pabst member usually contains enough magnetite to be followed readily with a dip needle.

THE IRON CARBONATE SLATES

North of the Pabst member the iron carbonate slates of the Tyler formation are known for varying thicknesses up to 300 ft. in a few drill holes and in outcrops along Black River. They are very thin, even-bedded carbonate slates similar to the ferruginous slates in the Yale and Pence members. In the region of the Montreal and Plumer mines these sideritic slates contain 20 to 25 per cent of iron, with an occasional analysis as low as 15 per cent for about 150 ft. north of the Pabst member. North of this there is a rather abrupt change to an iron content of about 12 to 15 per cent, with some analyses down to 10 per cent. This continues for another 150 ft., and then there appears the soft gray slate, with only about 5 per cent of iron. Section 11 of Fig. 17 shows to the north of these carbonate slates finely banded, somewhat purplish gray slates, which, in turn, are succeeded about 150 ft. farther north by soft, black, highly carbonaceous slates. These slates seem to be fairly persistent and continuous farther to the west, and their soft character is frequently indicated in the topography by a depression. To the east of this section little is known of the character of the slates this far north of the Pabst member.

UNCONFORMITIES

There are unconformities marked by conglomerates and fragmental deposits at the base of the Plymouth, the base of the Pence, and separating the Anvil from the Pabst member of the Tyler graywacke slate formation. Similar unconformities have been described in other iron ranges of the Lake Superior district, but too little detailed work has been done upon them to make it possible to make proper correlations.

The unconformity between the foot-wall quartzite and the iron formation is not marked by a large amount of erosion, so far as facts are available at present. The quartzite phase of the Palms is everywhere present, and its thickness does not vary over 75 ft., a variation that may be due to original deposition or to erosion.

The unconformity between the Norrie and Pence members possibly represents the erosion of 150 ft. of beds—not a large thickness and probably indicative of a brief erosion interval. Part of this variation in thickness may be due to differences in original thickness, but not all of it. This also represents a brief period of erosion.

The longest period of erosion is that between the deposition of the Anvil member and the beginning of the deposition of the Pabst. The Anvil member is known to vary from nothing to 375 ft. in thickness, and it is probable that this whole variation is due to erosion. This fact and the invariable conglomerate at the base of the Pabst mark this also as probably the longest erosion interval; in other words, the greatest unconformity at present known between the base of the Palms and the base of the Keweenawan.

The conglomerate near the top of the Plymouth member, or at the base of the Yale, is not known to represent any appreciable period of erosion, but it is possible that it may, and evidence on this point should be sought in future work.

There is little doubt that other minor unconformities such as those described would be found in the Tyler graywacke slate if exposures or drilling were sufficiently abundant to show them up.

More detailed work must be done on the Gogebic Range and on all other Lake Superior iron ranges before it can be stated whether or not any of these apparently minor unconformities will necessitate a revision of the present correlation of the Lake Superior Huronian formations.

(*To be continued*)

Ray Consolidated Copper Co.

The thirty-second quarterly report of the Ray Consolidated Copper Co., covering the second quarter of 1919, states that the gross production of copper in concentrates for the quarter is as follows:

RAY CONSOLIDATED COPPER CO. COPPER OUTPUT, SECOND QUARTER, 1919

	Pounds
April	3,756,371
May	3,807,538
June	3,742,209
Total	11,306,118
Average monthly production	3,768,706

In addition to the copper derived from the concentrating ores, 361,583 lb. of copper was contained in ores sent direct to the smelter, making the total gross production from both sources for the quarter 11,667,701 lb., as compared with 12,471,729 lb. for the previous quarter.

During the period under view there were milled 391,500 dry tons, averaging 1.827 per cent copper. This tonnage corresponds to a daily average of 4,302 tons, as compared with 4,891 tons for the first quarter. The mill extraction was 79.06 per cent of the total copper contained in concentrating ores, as compared with 77.88 per cent for the previous quarter. The underground development was 3,437 ft., making the total development to date 692,065 feet.

The milling cost was $1.23 per ton, as compared with $1.20 for the previous quarter, both exclusive of Federal income and excess-profit tax. The average mining cost of ore milled for the quarter was $1.63 per ton, of which 4.96c. was the cost of coarse crushing, leaving the net mining cost $1.58 per ton, as compared with $1.64 for the previous quarter, both exclusive of income and excess-profit tax.

The average cost per pound of all net copper produced for the quarter was 14.64c. This figure does not take into account credits for the value of the gold or silver, nor for miscellaneous income, and compares with a cost of 15.15c. similarly calculated for the previous quarter. These costs include a charge of 15c. per ton of ore milled for the retirement of mine development expenses, but are exclusive of estimates for Federal income and excess-profit taxes. Miscellaneous income for the quarter, including net receipts from gold and silver produced, amounted to 2.72c. per lb. The financial results of operation for the quarter are:

FINANCIAL STATEMENT, RAY CONSOLIDATED COPPER CO., SECOND QUARTER, 1919

Net operating profits	$18,275.04
Miscellaneous income	298,090.34
Total	$316,365.38
Disbursement to stockholders	788,589.50
Net deficit for the quarter	$472,224.12

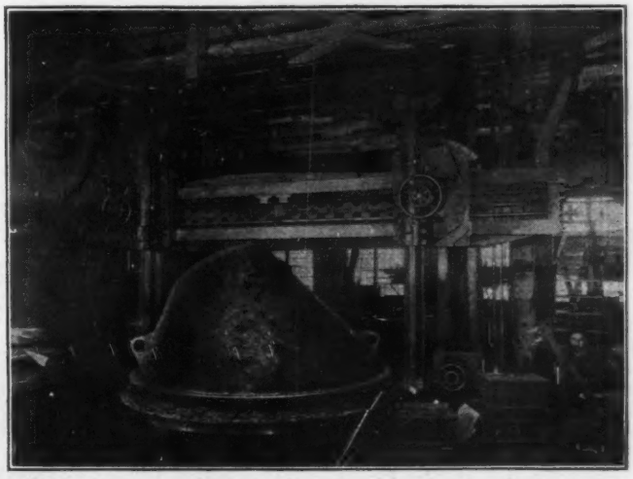
This statement compares favorably with that of the previous quarter, for which the net deficit was $940,-887.55.

The average carrying price of copper for the quarter was 14.80c., as compared with 13.13c. for the previous quarter. A quarterly distribution to stockholders of 50c. per share was paid June 30, and amounted to $788,-589.50. Total of such distributions from the beginning of the company's operations to the end of the second quarter of 1919 amounted to $22,258,262.67.

The output for the quarter was approximately 50 per cent of normal. Operating conditions have become adjusted to the lesser production, accounting for the decrease in the cost per pound as compared with the previous quarter. During this period, the plants have been kept in readiness to return, upon short notice, to full capacity.

A Large Boring Mill

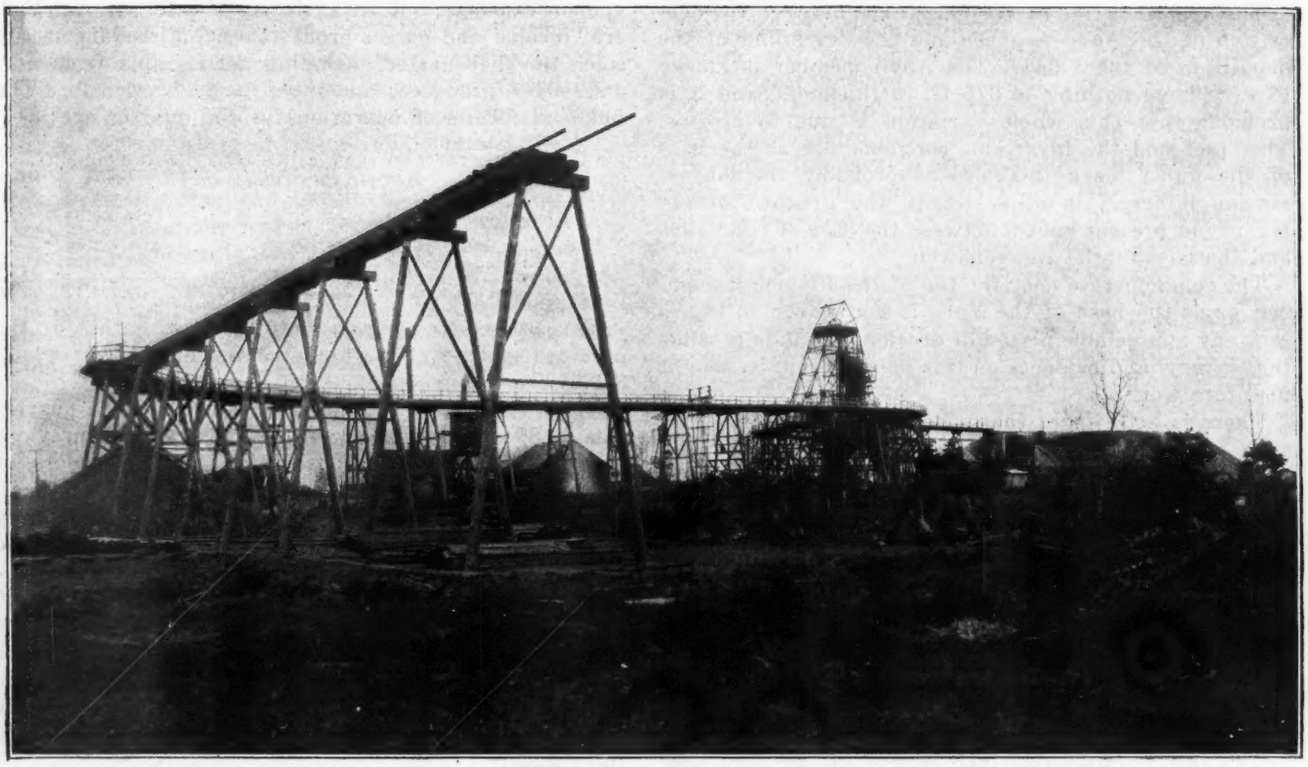
The photograph shows a large boring mill in the Worthington Pump & Machinery Corporation plant at Cudahy, Ill., turning out a top for a 12-ft. diameter copper converter. This top has a maximum diameter of



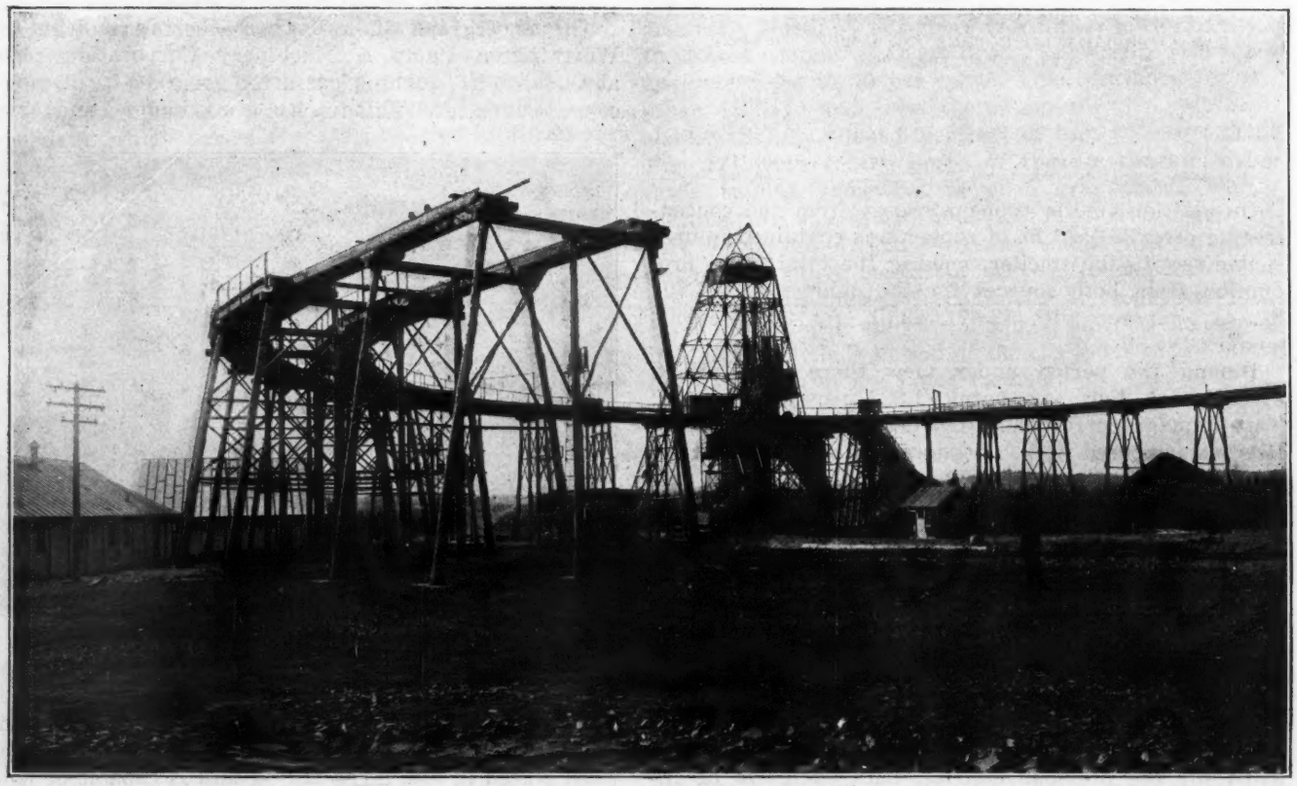
A 12-FT. DIAMETER COPPER CONVERTER IN COURSE OF COMPLETION

13 ft. 6 in. and weighs approximately 18,000 lb. The casting is of steel and is arranged to be lined with brick when placed in use. The boring mill is capable of handling work up to 24 ft. in diameter.

Stock-Pile Trestles in Northern Michigan

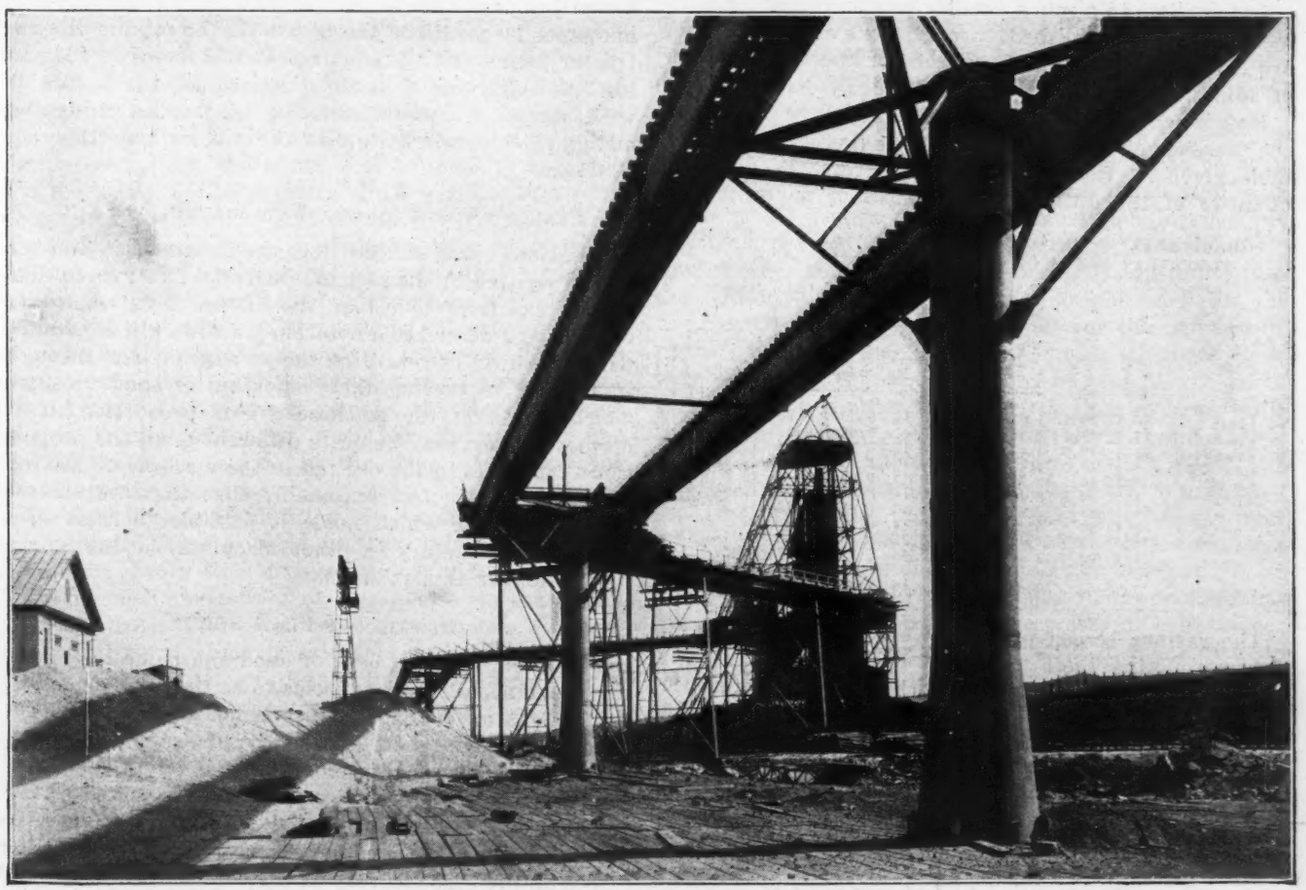


TRESTLE USED AT THE FRANCIS MINE OF THE CLEVELAND-CLIFFS IRON CO. AT GWINN, MICH.



TYPE OF TRESTLE AT MORRIS MINE, IN THE NORTH LAKE DISTRICT OF THE MARQUETTE RANGE

ONE-LEG WOODEN TRESTLE AT PASCOE SHAFT OF REPUBLIC MINE, REPUBLIC, MICH.



PERMANENT STOCKING TRESTLE AT NO. 3 SHAFT, NEGAUNEE MINE, NEGAUNEE, MICH.
Piers are set at 114-ft. centers. Height to top of rail is 42 ft.
(Photos of this series are by Childs Art Gallery, Ishpeming, Mich.)

Notes on Troubles From Colloids in Flotation

Review of the Opinions of Flotation Experimenters on the Subject—Advantage of the Presence of Granular Sand—Physical and Chemical Theories—Effect Of Metallic Iron in the Ore Pulp

SOME notable papers dealing with the effects of colloids on flotation have recently been published. The phenomenon is well known to every operator of the flotation process. It consists in the fact that otherwise good flotation ores cease to be amenable to treatment by the process when they contain more than a certain amount of matter of a colloidal character.

The term "colloidal" may require defining. A. Schwarz[1] calls attention to the formation of colloids from the flotation oils, tars, and like substances, and objects to the term "colloid" applied to ore slime. Though the dispersion of such slime may not be fine enough to fall strictly into the "colloid" class, the word is used here in a broader sense, as it has been employed by many others without implying any assumption about the fineness and the degree of dispersion.

The action of the colloidal material, which exists in all ores to a varying extent and which is produced by the natural decomposition of the ore deposits, has so far received the greatest attention. The phenomenon has occasionally been described as an influence of the primary slime on flotation.[2] Although slime formed by the crushing of the ore in the milling process (secondary slime) generally shows the characteristic action of the primary slime to a much smaller extent, it has recently been definitely established, through work on molybdenum ore carried out by Will H. Coghill for the U. S. Bureau of Mines, that it may also be decidedly harmful.

How much the flotation qualities of an ore vary with the presence or absence of primary slime is shown in a table given by Rudolf Gahl, representing the flotation qualities of the different screen-sizes of an ore:

SCREEN-ANALYSIS OF ORE DRAWN FROM MILL BINS AND FLOTATION TESTS OF DIFFERENT SCREEN-SIZES

Screen Size	Per Cent by Weight	Cumulative Per Cent	Per Cent Total Copper	Copper Contents	Per Cent Oxidized Copper	Contents Oxide Copper	Flotation Results Per Cent Total Copper: Tails	Mids. + Conc.	Recovery Per Cent
+ 1 inch	30.8	30.8	1.05	0.324	0.13	0.40	0.22	12.8	60.5
+ ½ inch	17.1	47.9	1.34	0.229	0.11	0.19	0.22	17.4	84.7
+ 4 mesh	23.0	70.9	1.44	0.332	0.12	0.28	0.17	17.1	89.0
+ 8 mesh	4.3	73.2	1.42	0.061	0.12	0.05	0.17	16.3	88.8
+ 14 mesh	5.1	80.3	1.77	0.068	0.13	0.07	0.26	16.8	86.7
+ 28 mesh	4.1	84.4	2.14	0.080	0.14	0.06	0.61	16.3	74.3
+ 48 mesh	3.1	87.5	2.62	0.081	0.19	0.06	0.72	11.3	77.5
+100 mesh	2.4	89.9	3.29	0.079	0.24	0.06	0.63	22.5	83.1
+200 mesh	2.0	91.9	3.16	0.063	0.27	0.05	0.60	20.1	83.5
−200 mesh	8.1	100.0	1.53	0.124	0.43	0.35	1.57	1.48	....
Average	....	...	1.44	1.441	0.16	0.157	....	....	....

The various screen products were reduced to a fineness permitting their treatment by flotation and then tested in laboratory flotation machines. The inference may be drawn from the table that none of the sizes from which the primary slime had been removed offered difficulties in flotation, though the screen-size in which it collected did not yield to flotation at all.

In a paper issued by the Bureau of Mines[3], Frederick G. Moses explains the phenomenon by pointing out that the relations between gangue and economic mineral on the one side, and water and oil on the other side, are materially changed by the introduction of colloids, and that, therefore, the flotation qualities of the pulp which depend on these forces are changed also. Similar effects on the molecular surface forces are traceable to physical sources like heat, or to osmotic and electrical influences resulting from the addition of electrolytes. The benefit derived from heat and the addition of salts may therefore, it is reasoned, be ascribed to their action on the surface forces. This explanation, if used as a working hypothesis in experimental work, may well be the means of securing a clearer insight into the basic principles of the flotation process.

Granular Sand as a Remedy for Slime Troubles

The deleterious influence of primary slime on flotation is too well established to be doubted; it is a fact that many flotation operators know only too well. A question exists, perhaps, regarding the relative damage which it does. Moses mentions that when such slime is diluted by sand its effect is masked. This may be construed to mean that the slime is just as bad after the mixing as before, but it does not appear that Mr. Moses intends to state this, because in another place in his paper he mentions the possibility of mixing the refractory slime with granular ore as a remedy. "Masking" the effect of a harmful ingredient by mixing it with normal ore would certainly be the last thing the metallurgist should do, unless the mixing had other advantages.

Pearce's Work on the Retardation of Sand

Questions along similar lines are discussed in another article written by Jackson A. Pearce[4]. Mr. Pearce, like others, has tried to utilize the known facts regarding colloids, and describes a flotation machine which he built with the object of retarding the passage of sand through it, thereby increasing the proportion of sand to slime which exists in the machine. This proportion, it is needless to say, may be quite different from the proportion that exists in the ore fed to the machine or leaving it. He seems to feel reasonably sure that the success of his machine, which made it possible to treat ores that were refractory in other machines, is due to the application of this principle.

Question of Flow Sheet

The combined treatment of sand and slime in a flotation machine, although it seems to be the correct method for the treatment of some ores, cannot claim to serve for all ores, for though it apparently presents advantages for the recovery of refractory fines, it offers the drawback that it introduces coarse grains, which are naturally difficult to lift, into a medium which itsef may be quite refractory. In cases where emphasis has to be placed on the best recovery of the coarse mineral grains, it seems to be the best course to treat such granular

[1] *Chem. & Met. Eng.*, Vol. 19, 1918; p. 701.
[2] Rudolf Gahl, "History of Flotation at Inspiration," *Trans.*, A. I. M. E., Vol. 55, 1917; p. 576.
[3] Technical Paper No. 200, U. S. Bureau of Mines, "Colloids and Flotation."
[4] *Min. & Sci. Press*, Vol. 117, No. 15; Oct. 12, 1918; p. 491.

material separately and to avoid all contamination with colloidal matter. This procedure, previously recommended by Rudolf Gahl for certain cases, is also advocated by Mr. Pearce, and apparently practiced by him.

As far as the selection of the proper flow sheet for a certain ore is concerned, it seems to be preferable to treat the combined sand and slime, if no serious difficulties are encountered in the recovery of the coarse mineral, and to provide separate treatment if the flotation of the coarse grains is difficult, provided that the slime by itself is not refractory. In other cases a combination treatment would seem to be the logical solution.

Are the Physical or the Chemical Qualities of Primary Slime Responsible for Its Action in Flotation?

Although there does not seem to be any doubt that the colloidal primary slime is decidedly harmful in flotation operations, it is not absolutely established that the colloidal properties are what causes the trouble. For it is a fact that that portion of the ore also differs in other qualities from normal ores. The ore freed from slime, for instance, when brought into contact with the mill solution, may give up hardly any soluble constituents to the water, but the primary slime, when treated with water by itself, often sets free noticeable quantities of such salts. Although no analysis of such solutions is available, it seems reasonable to suppose that in the case of copper ores they contain iron and copper salts and probably organic matter also.

To decide what characteristic of the slime causes the harmful effect would seem to be an easy matter. Segregating one part from another should give the answer. This has been tried by thoroughly and repeatedly washing the slime with water. The flotation treatment of the washed slime gave better results than that of the natural slime, but it was still far from being satisfactory. One might, therefore, feel tempted to conclude that the action of the primary slime was due to a combination of its physical and chemical qualities, if certain that all the chemical ingredients that might cause the action had been removed by washing. However, this conclusion may not be safely drawn, as it might well be that the adsorption of the salts to the colloidal slime particles is of such a magnitude as to prevent thorough elimination of the harmful ingredients by simple washing. A possibility seems to remain, therefore, that the colloidal fraction of the ore is not harmful by itself, but that all the harm is done by the chemical products of the natural decomposition.

The fact that small additions of chemicals sometimes are decidedly helpful would perhaps better agree with a chemical theory than a physical one, although the addition of small amounts of chemicals also influences the physical characteristics of ores, for instance, by causing coagulation, which is said to be of prime importance. A comparison of the settling qualities of slime to which various chemicals are added, with the flotation qualities of such mixtures, would help to clear this question. So far, apparently, no such relation has been established.

A reference should be cited here that might be investigated, because it could have a bearing on these questions. It is contained in a British patent granted to A. A. Lockwood[5] and points out the advantage of agitating slime with granular, preferably siliceous, sand previous to subjecting it to the gravity-concentration process. The inventor claims that, by doing this, gangue materials that have a tendency to float, like mica, are by the preliminary treatment kept from doing it. The similarity with the case under consideration, where the admixture of sand is regarded as beneficial, because it prevents an excessive amount of gangue material from floating, is apparent, and points perhaps to a relation between the two phenomena.

[5]British Patent No. 174: 1915.

Influence of Iron on Refractory Ores

In his paper quoted above Rudolf Gahl stated that the presence of metallic iron in ore pulp, refractory because of the presence of primary slime, has a decidedly beneficial influence. This statement has been commented on by various investigators.

Coghill[6] mentions that in laboratory tests of some Oregon copper ore he found it decidedly harmful to reduce the ore in a disk pulverizer, because this introduces some metallic iron into the ore pulp. This does not, of course, contradict the statement about the beneficial influence of iron in other cases, but it might be interpreted to raise a doubt.

Zachert[7] offers an explanation of the effect of metallic iron. He ascribes the improvement resulting from the substitution of steel balls for pebbles in a ball mill to magnetic forces which are absent when the grinding is done with an unmagnetizable medium like pebbles.

Moses[8] calls attention to the fact that although in his opinion a beneficial influence of the metallic iron in all probability exists, it should not be forgotten that the improvement which has been noticed to result from the substitution of a Marcy ball mill for a pebble mill with center discharge might also be due partly to the substitution of the open-end discharge which the Marcy mill possesses for the center discharge.

The action of the metallic iron offers an interesting problem. The most natural explanation might be that the improvement results from the neutralization of acid in the pulp. The fact that the same action does not result from the addition of iron oxides, or from the addition of other metals, does not necessarily contradict this assumption. Another explanation might be based on the fact that metallic iron must destroy the copper sulphate. Still, the percentage of copper sulphate in a very refractory primary slime may be exceedingly small.

One may be tempted to connect this phenomenon with that of over-voltage met in the electrolysis of aqueous solutions. It is well known that certain metals, when used as electrodes in electrolytic processes in which gases are set free, facilitate the development of the gas and others impede it. To develop gas on the latter requires a higher expenditure of power than the development of gas on the former. The difference in the voltage required, which is a measure of the power, is called over-voltage. The gas also seems to form in much smaller bubbles on metals requiring little over-voltage and in large bubbles on metals that require a high over-voltage. What is required in the flotation process are small gas-bubbles, and the assumption that the presence of small quantities of metallic iron facilitates their formation would not seem preposterous. Most mill men are aware of the fact that when air is blown through a thickened pulp of colloidal slime enormous bubbles of air

[6]*Min. & Sci. Press*, Vol. 116, 1918; p. 194.
[7]*Min. & Sci. Press*, Vol. 114, 1917; p. 663.
[8]*Min. & Sci. Press*, Vol. 114, 1917; pp. 19, 20.

will form, which might at once be taken for an indication that such pulp is not suitable for flotation treatment. Thinning the pulp permits the formation of smaller bubbles, and it may well be that thinning pulp of such character brings about changes similar to the addition of iron.

In connection with what has been said on the influence of iron, attention might also be called to an expedient resorted to by chemists, when liquids are to be boiled which have a tendency to bump, that is, liquids which do not boil smoothly but which form a few big bubbles that burst explosively and are likely to break the porcelain or glass vessel in which the boiling is being done. It is the practice of chemists in such cases to add small glass beads or something of such character to the liquid for the purpose of conducting the operation with greater smoothness. May not the addition of sand to colloidal suspensions represent something similar, and therefore facilitate the flotation process?

In conclusion, it may be well to point out that what has been said is not so much meant to establish facts as to formulate questions. Others may find it easier on that account to contribute to their final solution.

Graphical Methods of Presenting Metallurgical Data

Suggestions for Plotting Mine and Mill Statistics To Show Periodical Variations.—System Used By the Chino Copper Co.

H. M. MERRY, metallurgical statistician of the Chino Copper Co., will present a paper at the Chicago meeting of the A. I. M. E. on "Graphic Metallurgical Control." Construction of charts to show periodical variations in mine, mill, or smeltery operations is commonly done to a greater or less extent in most works, as metallurgical results, their causes and effects, can be much better comprehended when presented in graphic form. Mr. Merry has made a study of the subject, and gives some of the principles which should be followed in the preparation of such charts, well illustrated by numerous examples.

Two kinds of co-ordinate papers are employed. In the semi-logarithmic method, logarithmic horizontal ruling and arithmetical vertical ruling are used. Time is laid off on the vertical lines and values are assigned to the horizontal logarithmic scale. In the other method, called the special arithmetical method, millimetric-ruled cross-section paper, available in 50-yd. continuous rolls 22 in. wide, has been found most satisfactory. Sheets 4 ft. in length, of full width, are recommended for the charts.

The notation of the scale should be so arranged as to display the various factors with due prominence. Assay values of heading and tailing, which are the minimum and also the governing factors, should be exaggerated. Beyond the maximum range of heading assays of valuable metal, the scale may be reduced, the concentrate assay values, dilutions, and extraction falling principally in this range. The tonnage scale should be devised to meet the maximum and minimum variation and may include concentrate production. It is permissible to overlap the tonnage and percentage scales, preferably in multiples of ten, employing lines of different weight or color to distinguish them in conflicting areas. Abnormally high or low points that fall outside the limits of the particular scale should be plotted on the projection of the scale in which they originate, as breaking scale destroys the proportion of the relationship with other lines.

A record of departmental milling costs and general statistics may be kept on separate similar sheets, changing the scale from logarithmic notation to direct arithmetic, covering the necessary range of magnitudes.

Upon sheets of the same size, a monthly graphic record of tonnage of ore mined and yardage of waste stripped is kept by the Chino company, with incidental costs of various operations. Corresponding deep-mining data can be added or substituted with facility.

Half-Year Pig-Iron Output Decreases*

Pig-iron production in the United States for the first six months of 1919, compared with both the first half of 1918 and the last half of 1918, shows a material loss. If production for the last six months of this year is continued at the same rate as during the first half, the 1919 total will fall 6,495,641 tons below that of 1918. The slump in blast-furnace activity from January to June is responsible for the low production figure. Judging from the improved production of July and the number of idle stacks blown in during the month, the last six months' total will be considerably larger, with the result that the 1919 output may compare favorably with the 1918 output.

According to the statistics compiled by the American Iron and Steel Institute, the production for the six months ended June, 1919, was 16,278,175 tons, 1,949,555 tons less than for the same period last year and 4,546,086 tons less than for the six months ending Dec. 31, 1918. Of the 16,278,175 tons produced, 16,036,218 tons was made with coke, compared with 17,933,932 tons for the first half of 1918 and with 20,488,243 tons the last half of 1918. Anthracite iron, with 67,592 tons, fell from 120,404 tons and 163,188 tons, respectively. Charcoal iron, with 174,365 tons, was about an average of the two six-month periods last year.

Production of pig iron by grade shows the following: Basic, 7,910,295 tons; bessemer and low-phosphorus, 5,181,621 tons; foundry, including ferrosilicon, 2,436,023 tons; malleable, 465,823 tons; forge or mill, 104,874 tons; ferromanganese, 106,056 tons, and spiegel, 38,136 tons. Merchant iron or iron made for the market totaled 4,499,133 tons, and iron made for the maker's use 11,779,042 tons.

Total Value of the Minerals produced in the U. S. during 1918, according to the U. S. Geological Survey, was about $5,526,000,000, more than half a billion dollars in excess of the value recorded for 1917, but the total quantity produced was less. The value of the metals produced was about 3 per cent greater in 1918 than in 1917. The figures show that less iron ore and steel were produced, but here, again, values were higher. A little more pig iron was made, though the quantity shipped was less. Copper and zinc, not only in themselves but as the components of brass, are perhaps next in importance to iron in the world's industry; and in 1918 they stood high on the list of war metals. A little more copper but less zinc was produced, and the values of both were lower, that of zinc falling about 25 per cent. The output of the war metals manganese and chromite, used in hardening steel, was greater than in any preceding year. Chromite increased 88 per cent in quantity and 275 per cent in value over 1917, and the increases in manganese ore were 136 and 100 per cent, respectively. Less gold and silver were mined than for many years.

*Extracted from *Iron Trade Review*, Sept. 4, 1919.

Sinking the "H" Shaft at the Pabst Mine

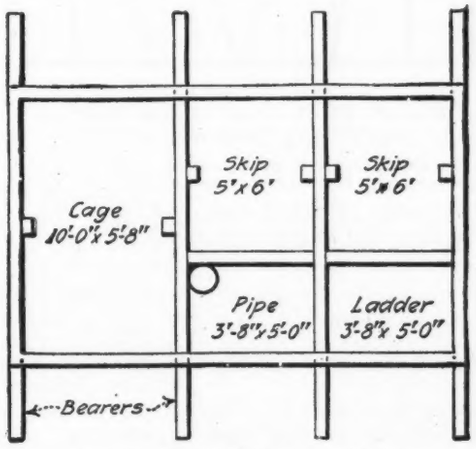
High Drilling Efficiency and Low Maintenance Cost Obtained by Careful Inspection and Overhauling of Drilling Machinery—Well-Planned Sequence of Operations and Arrangement of Equipment Assured Excellent Progress

BY A. J. WAGNER

GROUND was broken on June 20, 1917, at the "H" shaft of the Pabst mine of the Oliver Iron Mining Co., Ironwood, Mich., and in March, 1919, the shaft, having a depth of 1,830 ft., was completed. During this period all steel sets, bearers, dividers, concrete lath, and skip runners were placed, and, in addition, all stations were cut, pockets built, and cages and buckets put into operation. When the work was started it was decided to make each part of the job as complete as possible while sinking proceeded, for it was believed that in the long run time would be saved by so doing, rather than to push the sinking and then complete the steel work and equipment later.

It is questionable whether the progress made on the sinking and equipment of this shaft has been equaled in this district. No serious accident occurred from start to finish.

The shaft is vertical, with outside dimensions of 18 ft. 4 in. x 11 ft. 4 in., and is divided into one cage compartment, 10 ft. x 5 ft. 8 in.; two skip compartments, each 5 ft. x 6 ft.; one pipe compartment, 3 ft. 8 in. x 5 ft., and one ladder compartment, 3 ft. 8 in. x 5 ft.

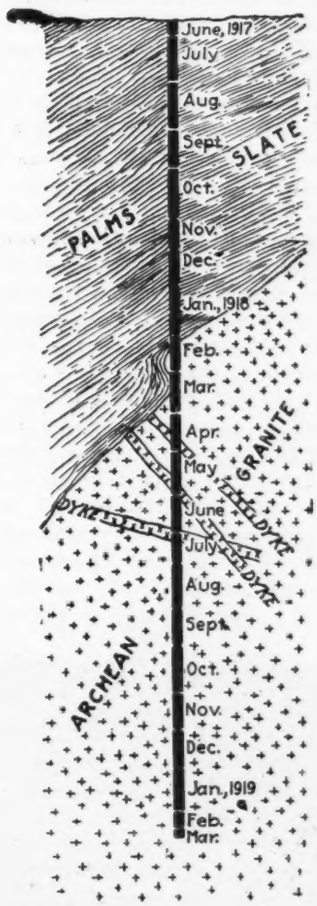


PLAN OF PABST "H" SHAFT

The long axis of the shaft was placed perpendicularly to the strike of the formation, taking the natural ground slippage on the end of the shaft. This is the first shaft so situated on the Gogebic Range. In sinking, the first nine feet was overburden, and this was followed by slate that continued to a depth of 725 ft. At this point granite was cut, and granite with dikes continues to the bottom of the shaft 1,830 ft. from surface. The vertical section in an accompanying cut shows the history, geological conditions, and monthly progress.

The sinking crew consisted of eight miners and one shift boss on each of three eight-hour shifts, making a total of 27 men. These men performed all the work in the shaft, such as drilling, charging, blasting, mucking, and timbering.

The drill equipment at the beginning consisted of twelve Butterfly Jackhamers, Type BCR430, equipped with ⅞-in. hollow hexagon steel and four-point bits. These were used in the slates to a depth of 589 ft., at which point harder ground required a stronger and heavier drill. Twelve Jackhamer sinkers, Type DDRW13, then replaced the Butterfly machines. The



SECTION SHOWING PROGRESS AND MATERIAL CUT IN SINKING THE PABST "H" SHAFT

factor of primary importance in speed of sinking is to break the ground, and the remarkable accomplishment of the drilling machines used in the "H" shaft made possible the fast record. As will be detailed later, a nine-foot sink the full size of the shaft was drilled, charged, and blasted in eight hours, the actual drilling of the full round, totaling 442 ft., requiring from five to six hours. The drilling time from start to finish of a nine-foot hole in granite averaged thirty minutes.

When material was removed from the shaft at the end of each drilling period the eight used drill machines were sent to the shop with the drill steel, and each machine was opened, inspected, cleaned, and lubricated before it was returned to the shaft. The result was an

extremely low maintenance cost and a uniformly high drilling efficiency. The warehouse record shows a maintenance cost for the year 1918 to have been only $2.51 per month per machine. As each machine drilled 6,000 lineal ft. in hard ground, the cost of maintenance was $.005 per foot drilled. As convincing proof of the value of high-grade inspection and careful lubrication it may be stated that, upon completion of the shaft, the drills were mounted and placed in service on the main level drift and on sinking work at other mines.

As ⅞-in. hollow hexagon steel was in stock, this size was used in the sinkers, although they were designed to use 1-in. steel. The drill steel was made up with two-foot starters, and the last drill was eleven feet long. The bits were standard four-point with a 90° cutting edge and 5° and 14° taper. The gage of starters was 2⅜ in., with ⅛-in. change in gage and 18-in. change in length. The steel was machine sharpened at the collar of the shaft in a No. 5 Leyner sharpener. No difficulty was encountered with steel breakage or inability to make the drills "follow."

Air for the machines was supplied by a 6-in. air pipe provided with a standard manifold. A specially designed header was discarded early in the work, as its use was found to be troublesome.

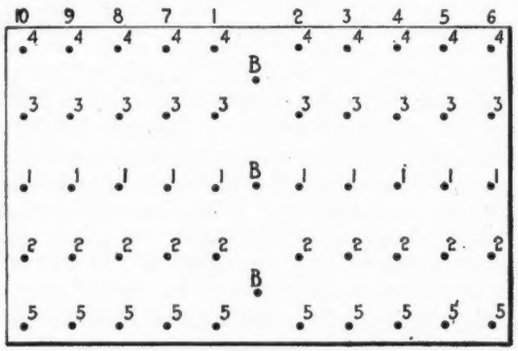
The cut was drilled so as to remove, when blasted, a "V" at the center of the shaft, and consisted of five rows of five holes each in each half of the shaft, with three extra holes drilled straight down across the center of the shaft. An accompanying diagram shows a plan and section of the distribution of the holes.

In the diagram fifty-three holes are shown. In slates fifty holes were drilled, the three center holes marked "*B*" being omitted. The numbers on the holes refer to the order of blasting. The three holes marked "*B*" were shot by means of a battery to relieve the cut. The holes numbered 1 were fired first; 2, second, and the others in rotation, and the row numbered 1 was fired first; row 2, second, and succeeding rows in like order, the rows up to 6 being shot and then this part mucked out. Rows 7, 8, 9, and 10 were next fired in sequence,

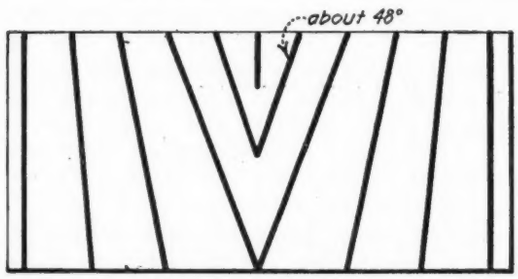
SHAFT-SINKING CREW AT PABST MINE, IRONWOOD, MICHIGAN

completing the cut. By firing in this order a wiggle, or staggered, effect was obtained, throwing the dirt from side to side, breaking any big blocks loosened, saving the shaft timber from damage, and putting the entire charge off as it was timed to go, without prematurely exploding other holes. Delayed fuses were used and the holes charged with eight sticks of 80 per cent Red Cross gelatine, the detonator being placed in the fourth stick from the bottom. This arrangement is contrary to the rule for placing the detonator, but owing to the fact that the holes are close together, the collar often breaks prematurely and tears out the detonators that have not been exploded. When this happens some of the holes do not explode and too much burden is placed on other holes.

No cut failed to be pulled clean, and not one steel shaft set was bent, although the sets were kept within fifteen to twenty feet of the bottom. The blasts were timed so close together that the effect was to blend the concussion in one slow, rattling blast.



Plan
(Drilling and Blasting)



Vertical Section

ORDER FOLLOWED IN BLASTING MACHINE-DRILLED ROUNDS AT PABST "H" SHAFT

After blasting, the muck was hoisted in two 20-cu.ft. sinking buckets, provided with special guides. At the trestle landing the buckets were dumped while hanging straight on the cable, the rock falling on an inclined shaft cover. This sloping cover was hinged, provided with high sides that formed a chute, and was swung in and out of position by means of air-operated cylinders. The complete cycle of work in sinking was as follows:

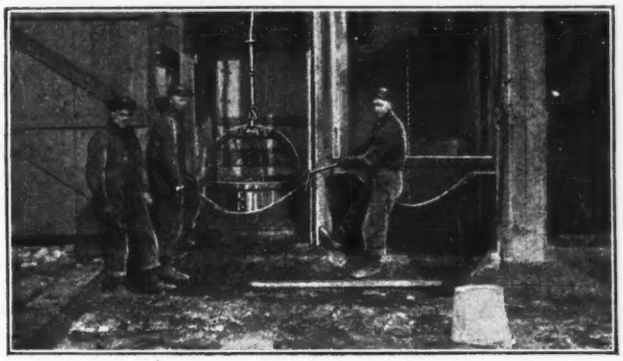
TIME REQUIRED PER CYCLE OF WORK IN SINKING PABST "H" SHAFT

Operation	Time, Hours
Take down material and drill entire cut	6.0
Charge holes (first blast)	1.0
Remove material and blast	1.0
Blow smoke	1.5
Muck first blast	8.0
Charge second blast and fire	0.5
Blow smoke	1.5
Muck second blast	6.0
Hoisting water with bucket, per day	1.5
Timbering, per set	5.5
Cutting and blasting hitches	8.0
Installing bearers	3.0

The shaft sets extending through the encountered slates are made of 8-in., 34-lb., "H"-section steel and 6-in., 22.8-lb., "H"-section throughout the remainder of the shaft. They were spaced at 5-ft. centers. Dividers were of steel. Bearers were placed every 100 ft. in depth, four bearers to a set, one under each end plate and one under each cross divider. The bearers are 12-in., 31.5-lb. I-beams, 17 ft. long, cut in the middle for purpose of installing and spliced after being placed.

Hitches 3½ ft. deep were cut to fit the steel, and this was done by drilling one side and the bottom of each hitch, the holes being placed side by side, each hitch requiring nine holes. Iron wedges secure the bearers.

The lath or lining consisted of pre-cast concrete slabs 8 in., 10 in., and 12 in. wide by 4 ft. 10 in. long and 3 in. thick in the slates and 2 in. thick in the granite. The slabs were designed with one vertical edge on each face, beveled to permit easy installation, and held in place by angles riveted to the "H" sections. The lath was wedged from the rear with cedar blocking. Men and material were handled on a cage, and dirt was



HOIST COMPARTMENTS, COLLAR OF PABST "H" SHAFT

hoisted by buckets, the three hoisting compartments being used.

The equipment on surface was temporary, buildings and headframe as well as machinery. The machinery used was as follows:

Cage Hoist—One herringbone-geared drum, 48 in. x 36 in. Lake Shore Engine Works electric hoist driven by 112-hp. 440-v., slip-ring, General Electric induction motor.

Rock Hoist—One of two drum, 48 in. x 36 in. herringbone-geared, Lake Shore Engine Works electric hoist driven by 150-hp., 440-v., slip-ring, General Electric induction motor.

Surface Haulage—One Armstrong haulage plant, rawhide pinion and iron cut spur gear, geared to handle cars at 900 ft. per min., driven by 220-v., 50-hp., Westinghouse induction motor.

Air Compressors—Two 12-in. and 7½ in. x 12 in. Imperial, compound, short-belt drive, Ingersoll-Rand air compressors, each of 327 cu.ft. displacement at 210 r.p.m. and driven by 440-v., 50 hp., General Electric slip-ring, induction motors running at 1,200 r.p.m.; one 14 in. x 12 in. N. S. B. E., Chicago Pneumatic Tool Co. air compressor, of 487 cu.ft. capacity at 230 r.p.m., driven by 100 h.p. Burks, 220-v., slip-ring, induction motor running at 900 r.p.m., and one No. 5 Leyner drill sharpener.

The work of sinking this shaft was in charge of Gustaf Erickson, mining captain, and under the direction of A. G. Hedin, head mining captain. A. J. Wagner was in charge of drills and responsible for their performance.

Crude Barytes produced and marketed in the United States in 1918 amounted to 155,241 short tons, one-fourth less than the quantity marketed in 1917, and one-third less than that marketed in 1916, according to statistics collected by the U. S. Geological Survey. The average price per ton was $6.73, as against $5.66 in 1917 and $4.56 in 1916.

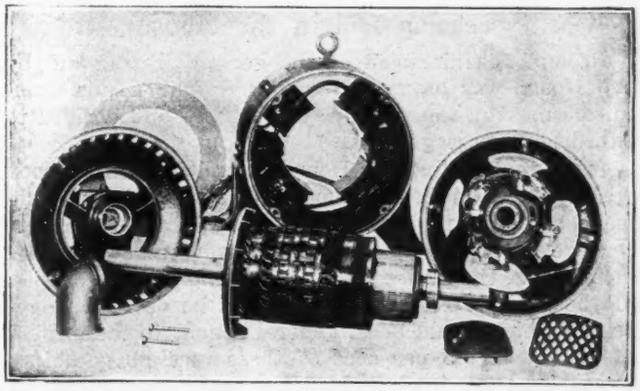
New Type of Direct-Current Motors

In the new type of commutating-pole, direct-current motors and generators which have recently been introduced by a large electrical machinery manufacturer, the following are included: Continuous rated (50° C. rise) motors, for application where the power requirements are definitely known; normal rated (40° C. rise) general-purpose motors; adjustable speed motors for continuous or intermittent service; generators and exciters.

For constant-speed motors, the ratings and speeds are the same as those of 60-cycle induction motors, and they can thus be used interchangeably with induction motors for direct-connected applications without changing the method of drive or the ratio of gearing. Adjustable speed motors, intended particularly for machine tool and similar applications, are provided for 2:1, 3:1 or 4:1 speed range. Generator speeds also correspond to those of induction motors, thus permitting the direct coupling of the machines to form motor-generator sets in various combinations.

The line of ratings now complete covers motors from one-half to 50 hp. and generators from one-half to 40 kw., and larger sizes are under development.

Box-type brush holders are adjustable for tension and suitable for either direction of rotation. Each holder can be removed independently with a screwdriver or wrench. At least two brushes per stud are used. The field coils are wound on metal spools, which prevent movement of the coils, and are protected by an outside layer of enameled wire. The armature core has the laminations riveted together, permitting the removal of the shaft without dismantling the core or commutator, and in the ratings of 20 hp., 850 r.p.m., and larger, the core and commutator are built on a sleeve, so that the shaft can be pressed out of the finished armature without disturbing the windings.



NEW TYPE OF DIRECT-CURRENT MOTOR DISSEMBLED

An important feature of the machine is the ventilating system. The air being drawn out by the fan mounted on the rear armature head, fresh cool air flows in through the ventilating ducts and takes up the heat. This heated air is forced out through openings in the periphery of the rear bearing brackets. With this ventilation, it is claimed, the internal temperatures are kept low, thus prolonging the life of the insulation.

This type, which is designated as the Allis-Chalmers Type "E," is completely new throughout. The motors are designed for belted as well as direct-connected applications and are particularly suited to machine-tool servi...

NEWS FROM WASHINGTON

By PAUL WOOTON
Special Correspondent

Magnesite and Other Tariff Bills

Despite the desire of Chairman Fordney of the Ways and Means Committee to have the House consider the bill providing duties on imports of magnesite, the parliamentary situation up to the time that this is written had not permitted him to get the bill before the House. It is expected that the magnesite bill will meet more opposition in the House than any of the other emergency tariff bills. This will be based largely on the claim that the bill will benefit only a few in this country and at the same time will strike a blow at large investments of American capital abroad, as well as increase the price of an important commodity which would be passed on to a very large number of ultimate consumers.

No steps have been taken as yet by the Senate Committee of Finance of which Senator Penrose, of Pennsylvania, is chairman, to take up the emergency bills. The committee is to meet at a date yet unfixed to decide on the action which is to be taken. There is no great amount of sympathetic interest in the bills, however, which are referred to in the Senate Committee as "popgun" measures. Many are of the opinion that they must await general tariff legislation. Heretofore, it has been assumed that the general revision of tariff would be undertaken immediately upon the convening of the regular session. It is the general belief now, however, that no such legislation may be expected until after the Presidential campaign.

Leasing Bill in the House

Prompt consideration of the general leasing bill by the House was assured when the Public Lands Committee took up the measure on Sept. 15 and decided to expedite its passage.

It is probable that the House Committee will not look with favor upon an amendment to the bill which would make available to the mining industry a certain percentage of the receipts obtained from licenses. Many members of the House are of the opinion that a portion of the receipts from licenses should be devoted to research which would be of general benefit to the mining industry. As 45 per cent of these receipts goes into the reclamation fund, and 45 per cent to the states, it is felt that at least the remaining 10 per cent should be devoted to the interest of mining, which is materially affected by the leasing bill.

Such an amendment to the bill was prepared by Senator Henderson, which would allow the 10 per cent going to the Treasury to be expended for such investigations by the Bureau of Mines as may be authorized by Congress. He refrained from pushing this amendment only when Senator Smoot, one of the Republican leaders and a member of the Appropriations Committee, went on record favoring special appropriations for various phases of mining research. Mr. Smoot's words in that connection were:

"While I am in sympathy with the object of the amendment, I think the leasing bill is not the proper place to bring it about. I will join with the Senator from Nevada in securing a direct appropriation for this purpose, and I will say that I have no doubt, as a member of the Appropriation Committee, that there will be an appropriation made for this very purpose."

It is Senator Smoot's idea that at least 10 per cent of all royalty which will accrue under the Leasing Act should be turned into the Treasury to pay the expense of administering the act.

Encouraged by the attitude of Senator Smoot, Senator Henderson expects to push for immediate consideration his bill providing $140,000 for an investigation of oil shale. In addition, he will introduce soon a bill providing for an investigation looking to the more economical production of slate. Owing to the increased prices of steel, lumber, and other building materials, there is an increased demand for the use of slate wherever it can be substituted for other materials in building and other constructional operations. At present only 5 per cent of the slate quarried is suitable for final preparation. An improvement in mining methods, he believes, will result in eliminating an important portion of the present loss. He has in mind, also, other investigations of interest to the mining industry.

Technical Men Needed as Consuls

A consular examination will be held in the late autumn or early winter. It is the hope of officials at the State Department that a considerable number of technical men will take that examination. The department recognizes that the interest of the United States will be served best if technical men are available to fill vacancies in the consular service at points where their training will be of special value.

For instance, a mining engineer, having passed the examination, would be considered especially for any vacancy at a foreign mining center and likewise a chemist would be considered for a center of the chemical industry.

The scale of pay in the consular service is so low that it is often difficult for a candidate without other source of income to maintain himself at the post to which he might be sent. For this reason many young men well suited for consular work find such a career unattractive. For that reason, as well as others, the department would welcome as consular candidates technical men of means who would be willing to accept such service.

Duty on Talc and Soapstone

Talc, steatite, soapstone and French chalk will be charged duty at the rate of 1 c. per lb. when imported into the United States if a bill introduced by Representative Fordney should become a law. If the product should be sawed or be in the form of crayons or cubes, the duty is to be 2 c. per lb., and manufactures of those articles, if not decorated, are to be subject to duty at the rate of 50 per cent ad valorem. If decorated, the duty is to be 60 per cent ad valorem.

F. J. Bailey on Present Mining Conditions

After a visit to all of the Western stations and branches of the Bureau of Mines, F. J. Bailey, the assistant to the director, who is in charge of the operating division of the Bureau, returns to Washington convinced that the mining industry is entering a new period of activity. Though the change from a war to a peace basis has put an end to some classes of mining, this will be more than offset by activities in other branches, he believes. He is especially gratified with the evidences of increased activities in the gold-mining industry.

One of the striking conditions which came to Mr. Bailey's attention during the trip is the immense amount of improvements which have been made on mining properties during the war period. The betterments which have been established are making for cheaper production and are making possible many of the activities now in evidence. He found that in most of the mining sections the transition from a war to a peace basis had been completed.

That the Bureau of Mines enjoys a considerable prestige among men engaged in the industry became more evident to Mr. Bailey, as a result of his visit to practically all of the important mining centers. He believes that the war gave the Bureau of Mines, as well as other Government agencies, an opportunity to display its worth to the industry. There is a unanimous demand, Mr. Bailey reports, for additional mining research and united effort looking to the solving of the industry's problems.

Exports of Mining Machinery

The exports of mining machinery from the United States during July, 1919, according to the figures of the Bureau of Foreign and Domestic Commerce, are as follows:

Countries:	Oil Well	All Other
Belgium	.....	$5,188
Italy	.....	3,526
Netherlands	.....	1,102
Norway	.....	16,765
Roumania	$158,641	.....
Spain	757	17,345
England	7,156	135,317
Canada	17,555	51,151
Honduras	76	1,000
Nicaragua	.....	5,781
Salvador	.....	901
Mexico	25,675	74,038
Miquelon, Langley, etc	.....	26
Newfoundland and Labrador	.....	142
Trinidad and Tobago	3,766	.....
Cuba	724	10,282
Argentina	14,951	980
Bolivia	.....	9,929
Brazil	.....	10,764
Chile	.....	100,144
Colombia	.....	11,173
Ecuador	.....	740
Peru	.....	22,891
Venezuela	13,003	.....
China	.....	97,093
British India	2,889	4,970
Dutch East Indies	51,496	10,220
Japan	.....	5,130
Russia in Asia	.....	37,346
Australia	.....	1,251
New Zealand	.....	493
French Oceania	.....	2,000
Philippine Islands	640	780
British West Africa	.....	4,102
British South Africa	495	10,689
French Africa	1,850	.....
Portuguese Africa	.....	27
Totals	$299,674	$653,286

Foreign Trade in Metals and Ores

Imports and exports of the more important metals and ores, as reported by the Department of Commerce for July, 1919, and the figures for July, 1918, as finally revised, are as follows:

IMPORTS, JULY, 1918, AND 1919

(In pounds, unless otherwise stated)

	July, 1918	July, 1919
Antimony ore, contents	1,119,077	226,246
Antimony matte, regulus or metal	1,400,030	1,219,458
Copper:		
Ore, contents	6,179,353	4,756,444
Concentrates, contents	5,185,245	2,902,900
Matte, regulus, etc., contents	1,533,838	5,758,470
Imported from (in part):		
Canada	2,104,426	3,610,480
Mexico	3,397,685	4,029,810
Cuba	2,120,720	856,000
Chile	3,417,904	3,186,163
Peru	350,175	123,112
Unrefined black blister, etc	19,543,854	18,033,812
Refined in ingots, plates, etc	5,389,000	3,116,315
Old, etc., for remanufacture	111,891	281,983
Composition metal, copper chief value	14,145	12,177
Lead:		
Ore, contents	3,597,906	2,711,964
Bullion, contents	2,134,609	12,575,262
Imported from (in part):		
Canada	2,209,572	1,376,588
Mexico	3,495,546	12,758,243
Chile	26,309	385,878
Pigs, bars and old	24,921	561,053
Pyrites, long tons	46,908	63,088
Imported from (in part):		
Spain, long tons	11,905	36,099
Canada, long tons	34,503	24,889
Tin ore, long tons	3,499	1,975
Tin bars, blocks, pigs, etc	15,567,667	113,120
Imported from (in part):		
United Kingdom	1,467,386	*Nil*
Straits Settlements	7,653,459	113,120
Dutch East Indies	2,653,136	*Nil*
Hong Kong	2,723,774	1,896,909
Zinc:		
Ore contents	1,193,916	4,225,489
Imported from (in part):		
Canada	829,327	196,515
Mexico	364,589	2,160,540
Blocks, or pigs, and old	*Nil*	*Nil*
Manganese ore, long tons	30,886	15,585
Imported from (in part):		
Cuba	9,702	307
British India	2,700	*Nil*
Brazil	15,925	9,750
Tungsten ore, long tons	858	452

EXPORTS OF COPPER, LEAD AND ZINC

(In pounds)

Copper:	July, 1918	July, 1919
Ore, contents	326,352	3,000
Concentrates, contents	127,000	*Nil*
Unrefined, black, blister, etc	672,000	3,600
Refined, in ingots, bars, etc	64,513,910	42,373,791
Exported to (in part):		
France	30,738,418	13,917,000
Italy	11,311,323	*Nil*
United Kingdom	199,595,996	7,676,212
Canada	2,766,126	1,406,066
Composition metal, copper chief value	7,690	25,409
Old and scrap	*Nil*	*Nil*
Pipes and tubes	173,557	334,563
Plates and sheets	377,148	436,843
Wire, except insulated	1,905,418	5,527,682
Lead:		
Pigs, bars, etc., produced from domestic ore	13,711,872	637,855
Produced from foreign ore	3,046,069	4,664,547
Exported to (in part):		
United Kingdom	7,430,468	3,472,560
Canada	5,880,469	119,650
Brazil	662,409	3,509
Japan	2,658,855	672,000
Zinc:		
Dross	2,023,402	72,000
Spelter:		
Produced from domestic ore	8,859,975	18,715,545
Produced from foreign ore	361,243	1,103,124
Exported to (in part):		
France	6,290,460	5,683,424
Italy	356,000	112,000
United Kingdom	2,186,547	11,442,341
Canada	373,891	340,694
Mexico	2,020	*None*
Japan	*None*	2,016,147
In sheets, strips, etc	1,461,441	2,008,580

Sale of Government Brass

Sealed bids have been asked by the Director of Sales for the entire surplus stock of brass held by the War Department. Fully 150,000,000 pounds will be covered by the sale. It consists principally of sheets, strips, bars, and rods. Full specifications and particulars of the sale may be had on inquiry to the Chief of Ordnance, Washington, D. C.

Dedication of U. S. Bureau of Mines Experiment Station at Pittsburgh

Program of Events Beginning on Sept. 29 Includes a Nation-Wide First-Aid and Mine Rescue Contest—Large Attendance Expected

THE dedication of the U. S. Bureau of Mines station at Pittsburgh will be held on Sept. 29 to Oct. 1. The Pittsburgh Chamber of Commerce will co-operate, and it is expected that a considerable number of members of the American Institute of Mining and Metallurgical Engineers will visit Pittsburgh after the conclusion of the Chicago meeting on Sept. 26. One of the features of the program of events scheduled for the three days will be a first-aid and mine rescue contest on Sept. 30, in which there will be nation-wide participation. The complete program is as follows:

SEPT. 29

8:30 a.m., Bureau building open for inspection.

10:30 a.m., dedicatory ceremonies in rear of main building, 4,800 Forbes St.

2 p.m., special train and automobiles to experimental mine near Bruceton, Pa.

3 to 6 p.m., mine explosion and inspection of experimental mine and explosives testing plant near Bruceton, Pa.

6 p.m., return by special train and automobiles to B. & O. station, Pittsburgh.

8 p.m., informal reception and organ recital Carnegie Music Hall. Arranged by Carnegie Institute of Technology.

SEPT. 30

Nation-wide First-Aid and Mine Rescue Contest, Forbes Field, Pittsburgh.

9 to 12 a.m., elimination mine rescue contests.

2 to 5 p.m., elimination first-aid contests.

5 p.m., coal-dust explosion.

8 p.m., pageant glorifying the mining industry, Forbes Field.

OCT. 1

9 to 12 a.m., final mine rescue contest.

2 to 5 p.m., final first-aid contest.

5 p.m., coal-dust explosion.

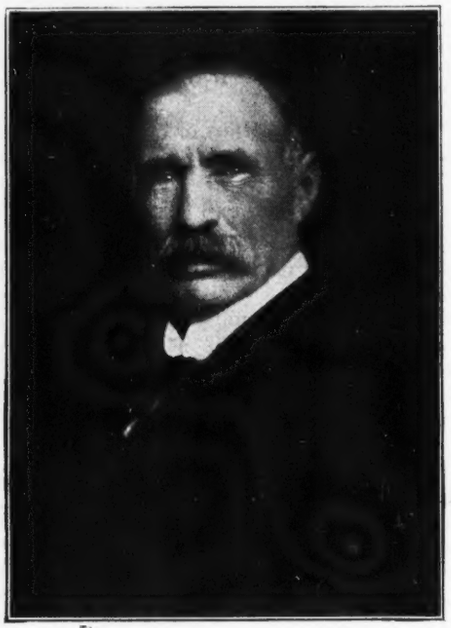
8 p.m., smoker, with award of prizes to winning teams.

Henry Clay Callahan

Henry Clay Callahan, prominently identified with the development of the mining industry in the West, died on Aug. 29 in San Francisco. Mr. Callahan was born at Callahans, Siskiyou County, Cal., on Oct. 6, 1852. His father, M. B. Callahan, one of the pioneers of 1849, who came to California in search of fortune, eventually became a prosperous merchant, conducting a business in mine supplies and similar products. The connections of his father, through his business interests with mining men of that time in California, Nevada, and Utah, enabled young Callahan to place himself advantageously. He began his experience underground in Virginia City, Nev., where he obtained employment in the Ophir mine as a carman and miner.

In 1875, at the age of twenty-three, Mr. Callahan went to Utah as superintendent of the South Star and Titus mines, on Emma Hill. He soon had other interests at Bingham Canyon, Utah, and in Tuscarora, and other mining camps in Nevada. In 1877 he went to Bodie, Cal., to take charge of several properties there.

Mr. Callahan finally established himself in New York as a mining engineer. During the Leadville, Col., excitement he took charge of the Bull Domingo mine, in Custer County. About the year 1880, he was on George Hearst's staff in Arizona and New Mexico. In 1883, Mr. Callahan returned to California and managed the Bonanza King mine, in San Bernardino County, for Thomas Ewing and Daniel Gillett, of New York. About this time he also went to examine the La Union mine, in Costa Rica, for Daniel Gillett, who represented the London Exploration Co.



HENRY CLAY CALLAHAN

In association with Henry Bratnober and Alfred Wartenweiler, Mr. Callahan went to Australia in 1893 to represent an English investment company there. In Australia he was prominently identified with the development of the Kalgoorlie gold fields, becoming superintendent and manager of the Lake View Consols and several other mines in that district. He was also manager for the London & Globe Exploration Co. In 1900 he was appointed one of the Queen's Commissioners from Western Australia to the Paris Exposition.

As a mining engineer, Mr. Callahan belonged to a conspicuous group of engineers who made mining history in the '80s and '90s by their ability to discover and develop orebodies and by their practical sense in management.

On account of ill health, Mr. Callahan practically retired from active participation in mining affairs in 1906.

Steel Production in Austria-Hungary, according to the *Ironmonger,* amounted to 1,763,745 tons in 1918, compared with 2,920,789 tons in 1917. Of this Austria produced 1,323,800 tons, compared with 2,204,139 tons in 1917; Hungary 426,476 tons, as against 692,429 tons in the previous year, and Bosnia 13,469 tons, as compared with 24,221 tons in 1917.

The Situation at Cobalt

Operators Win, But Victory Is Costly—Practically All Mines Flooded—Resumption of Work Will Require Time—Kirkland Lake Miners Still Out

TORONTO CORRESPONDENCE

THE Cobalt strike is over, and the men have gone back to work at the same pay and hours as before. The efforts of the Miners' Union to control the labor of the camp have been definitely broken, and no further trouble from this source need be expected, for a long time at least. Though it was a victory for the mine managers, this kind of victory is as usual a costly one. It is doubtful if the Cobalt camp will ever be as active as before the strike, or that there will ever be as many men employed again.

As far as can be learned the decision of the union executive to call off the strike was due in part to the firm attitude taken by the mine managers and also to the fact that the president of the American Federation of Labor, realizing the hopelessness of the situation, advised the union to throw up its hands. No strike pay was given, and the only assistance from the union was in the form of orders on the stores to those who were in actual want. As the applicant practically had to bare his soul before he got assistance, not much money was paid out.

Practically all the mines are flooded to a certain extent, so that it will be some time before operations are in full swing. It is believed that the resumption of work in Cobalt will have a beneficial effect upon the situation in Kirkland Lake and that the strike will be called off there also.

Minnesota Iron Country Statistics

The mine inspector of St. Louis County, Minn., in his annual report states that there was removed from the county during the fiscal year ended June 30, 1919, a total of 31,828,809 tons of iron ore, of which 9,575,514 tons was produced by underground methods and 22,252,295 tons by open-pit method. There was removed 14,124,832 cu.yd. of stripping. The number of men employed in all operations was 14,212. Fatal accidents for the year were thirty-three, as compared with sixty for the preceding year, which, after deducting the eighteen fatalities of the Sliver disaster, recorded last year, shows an improvement of more than 25 per cent for 1919 in this respect. There were twenty-one serious non-fatal accidents. One hundred and seventeen mines were active and forty-nine idle. Average wages throughout the industry were $5.55, as compared with $4.75 for the preceding year, an increase of 17 per cent.

The mine inspector of Itasca County reports that from this county was shipped 6,762,598 tons of ore in the year ended June 30, 1919, and 9,813,319 cu.yd. of stripping was removed. The season was marked by a large increase in the number of washing plants. There were twenty-four operating mines in the county and eighteen idle ones, and in all lines of mining endeavor 4,485 men were employed, at an average wage of $5.27. Seven fatal accidents occurred during the year, all in open-pit work. Both reports make pleased and long comment on the degree of co-operation afforded by the operator, and one of them frankly admits that the operators have in some instances outstripped the inspector in the effort to reduce injuries and suffering.

Monthly Copper Production in 1919

The table which appears herewith is compiled from reports received from the respective companies (except in the cases noted as estimated), together with the reports of the U. S. Department of Commerce as to imported material, and in the main represents the crude-copper content of blister copper, in pounds.

MONTHLY CRUDE-COPPER PRODUCTION, 1919

	May	June	July	August
Alaska shipments (*c*)	1,134,272	2,374,843	3,021,912	4,333,009
Arizona:				
Arizona Copper	2,400,000	2,400,000	2,400,000	2,900,000
Calumet & Arizona	4,308,000	4,872,000	4,802,000	4,814,000
Cons. Ariz. Smelting	690,000	625,000	650,000	650,000
Inspiration	6,200,000	6,300,000	6,000,000	6,500,000
Magma	730,548	936,117	903,179	.....
Miami	4,989,580	4,385,865	4,113,452	3,999,120
New Cornelia (*a*)	1,408,000	2,708,000	2,736,000	3,066,000
Old Dominion	2,564,000	2,015,500	1,629,000	1,937,000
Phelps Dodge	6,783,900	6,680,335	7,239,075	7,150,731
Ray	3,975,000	3,890,000	3,865,000	3,895,000
Shattuck Arizona	*Nil*	*Nil*	*Nil*	*Nil*
United Verde	1,250,000	3,525,000	4,040,000	.....
United Verde Extension	*Nil*	2,806,849	4,582,372	3,275,452
California:				
Mammoth	620,000	*Nil*	*Nil*	*Nil*
Michigan:				
Calumet & Hecla	6,796,819	5,439,761	6,208,517	7,586,601
Other Lake Superior (*b*)	6,500,000	5,750,000	5,750,000	5,750,000
Montana:				
Anaconda	13,500,000	10,530,000	11,122,000	12,600,000
East Butte	1,414,460	1,513,360	1,458,420	2,054,760
Nevada:				
Nevada Cons	3,700,000	3,715,482	3,706,103	3,706,103
New Mexico:				
Chino	3,583,396	3,615,458	3,626,354	3,321,857
Utah:				
Utah Copper	9,125,000	9,528,000	8,405,863	8,640,000
Eastern smelters (*b*)	1,400,000	1,400,000	1,400,000	1,400,000
Total reported	83,072,975	85,011,570	87,659,247	.....
Others, estimated	9,580,000	10,845,000	12,710,000	.....
Total United States	92,652,975	95,856,570	100,369,247	.....
Imports: Ore and concentrates etc.	7,946,560	7,732,950	13,417,814	.....
Imports in blister, etc.	15,997,164	19,842,478	18,033,812	.....
Grand total	116,596,699	123,431,998	131,820,873	.....
British Columbia:				
Granby Cons	1,848,802	2,072,964	2,050,000	.....
Mexico:				
Boleo	1,322,720	1,256,640	1,256,640	.....
Cananea	3,000,000	3,000,000	3,200,000	4,200,000
Phelps Dodge, Mexican properties	1,552,000	1,735,000	2,516,000	3,422,000
Other foreign:				
Cerro de Pasco	4,034,000	4,026,000	3,984,000	5,726,000
Chile	5,066,000	5,003,430	7,161,444	.....
Katanga	2,094,370	4,519,430	4,442,270	.....
Backus & Johnston	1,970,064	2,100,000	2,174,000	.....

(*a*) Only electrolytic cathodes are entered. New Cornelia also produces some copper from ores sent to Calumet & Arizona smeltery. (*b*) Estimated. (*c*) Official figures of the U. S. Department of Commerce; includes Kennecott production from its Alaska mines.

Production of the United States by months since the beginning of the year and the corresponding figures for 1918 were as follows:

	1918	1919
January	165,431,568	135,733,511
February	160,011,364	111,649,512
March	185,525,168	102,040,460
April	163,207,096	98,808,998
May	181,070,350	92,652,975
June	166,723,599	95,856,570
July	159,329,031	100,369,247

The grand total includes, under "Imports in ore and blister copper," the production of such companies as Granby, Cananea, Braden, Cerro de Pasco, and Chile. As a matter of record, however, the individual figures are given after the total. We also report the copper output of the Boleo and Katanga companies, which does not come to the United States.

The Shipments of Tungsten through the port of Bangkok, Siam, to the United States in the fiscal year ended March 31, 1917, amounted to 131,040 lb., and to 44,800 lb. in the fiscal year 1917-18, according to the U. S. Geological Survey. The production of tungsten practically ceased with the beginning of the current year, but Bangkok dealers in the ore are keen on securing new markets for stocks already on hand, and are ready to guarantee almost unlimited supplies for future shipments.

By The Way

The Largest Oil Reservoir

What is said to be the largest oil reservoir in Great Britain, if not in the world, was built at Rosyth during the war for the oil supply of British war vessels, according to a recent issue of *Ironmonger*. The reservoir is made of reinforced concrete, although it is founded on rock. Its size may be gathered from the fact that its roof area is 7½ acres or 35,493 sq.yd., the area covered by the reservoir and its associated works being 11¼ acres. Its walls are 35 ft. high; the amount of rock excavated was 300,000 cu.yd., and the amount of concrete poured, 98,500 cu.yd. The reservoirs capacity is 60,000,000 gallons. To ensure tightness a number of novel devices have been introduced, though when first tested these did not prove adequate, as the floor leaked considerably, and a complete new floor was laid. The reservoir is easily the largest oil reservoir in that country, and probably in the world.

The Fault of Overconfidence

"Some o' these 'ere chaps 'oo is braggin' tha 'ol bloody time," said Cap'n Dick, "is boun' to slip h'up naow an' again. Funny it be, too, m'son, 'ow there be them 'oo've 'eard a thing once or twice an', dam-me, soon they be tellin' un jus' as though it 'appened to they, whether or no. An', min' you m'son, perfectly h'innocent they be as they gaws h'on an' h'on, an' talks baout this an' that. A man 'asn't tha 'eart to call them liars, an' yet 'e naws they be far from 'ittin' tha truth. W'ot beats me is 'ow some o' these 'ere newspaper chaps 'as tha nerve to come h'out with a lot o' tha statements in the daily press that they do—an' tha next day they 'as to take un h'all back; but, min' you, m'son, tha tale is fixed h'up so h'artful that no one naws they wuz wrong at all. An' h'after that they believe they wuz right an' brags baout it, jus' like Billy Trevarthan. Billy, 'e'd been to one o' these 'ere circuses with some o' tha boys, an' comin' 'ome they wuz talkin' baout one o' tha dwarfs that they'd seen in tha side-show. 'Dam-me,' sez one o' tha boys, "e isn't very big, is un?' 'No,' says Billy, 'No. An' I tell e, m'son, h'over in h'ol country I've seen dwarfs twice as big as 'e.'"

D. E. A. C.

Treating 'Em Rough

In the Canadian Mining Institute Bulletin for July, "R. G.," referring to the widespread labor trouble in Canada, says: "It would be difficult, if not impossible . . . to prescribe a single remedy for its adjustment." On another page of the same journal, however, a single remedy used in England in the Fourteenth Century is cited. It was a statute passed in the reign of Edward III, which fixed the rate of wages, and compelled all, except artisans, merchants, or owners of farms, to work, when called on, at this rate of wages, or to go to prison. Another statute provided that if laborers or artificers left their work and went to another county they were to be arrested and brought back. A later law provided that a loafer should be tied to the end of a cart, naked, and beaten with whips throughout the town, "till his body be bloody by reason of such whipping." He was then required to take an oath to return home, "and put himself to labour, as a true man ought to do." If he made default, the whipping was to be repeated. If he persisted in not working, the upper part of the gristle of his "right ear was to be clean cut off." If still persistent, he was to be tried and executed.

The Gila Monster Not Monstrous

Visitors to the mining camps of Arizona have always been interested in seeing specimens of the Gila monster and hearing the natives tell of the marvelous characteristics of the reptile. One of the most common tales was that the deadly poison which the lizard was supposed to secrete came from food which was assumed to be in an advanced state of decomposition in the creature's stomach. The idea was that the alimentary tract was elemental in form, and partook of the characteristics of many of the desert rivers—that is, it just petered out without ever getting anywhere. Any food getting as far as the stomach was *spurlos versenkt*.

One story was to the effect that a cowboy fastened one of the reptiles on behind his saddle, and later, reaching around behind him, was bitten in the hand. He was rushed to Tucson, but the poison had permeated his system, and he died.

Now along comes Science to prove that, ugly looking as he is, the Gila monster has been grossly maligned. There is nothing unusual in his internal arrangements, and no authentic case of a death from his bite has been found. The cowboy story was true in every word—only said cowboy died several years after the bite. The Gila monster is, however, capable of secreting a poisonous saliva, the degree of toxicity varying in different specimens. The bite is often painful and causes swelling, but investigation shows that it is not in itself deadly.

Early Life in Nevada City

Glimpses of life in Nevada County, Cal., in the '50s, are caught as one reads the account that recently appeared in the *San Francisco Chronicle* of the visit paid by James M. Feeley, of Stockton, Cal., to Nevada City, where he worked a claim sixty years ago. Feeley, who is eighty-four years old, witnessed the great fire of 1856, which virtually wiped out the young town of Nevada City, and was also an eye-witness to the horse-whipping of Henry Shipley, an early-day editor, by Lola Montez at Grass Valley in the early '50s. He visited the site of his claim and cabin on Shady Creek, near Nevada City, the old scenes recalling an incident which he related as follows:

"One day when I returned to my cabin for dinner I found a man sitting at the table helping himself to my pot of beans. I was mad, of course, but restrained my anger when I recognized the intruder as the noted bandit, Tom Bell. I told him very politely to take anything he wanted, as I was not looking for an argument with Tom Bell. Tom ate his fill, thanked me and went away. A few days later I came to Nevada City and sold my gold dust for $500. While I was going back to Shady Creek I ran across the notorious Tom Bell just as he was in the act of robbing a couple of miners, and I decided at once that my $500 was lost. But Tom recognized me, and told me to pass quietly on and keep still. That I did, and my money was saved. Thus that pot of beans netted me $500. Tom was the terror of the boys in the mines for months, robbing right and left and always eluding capture."

PERSONALS

H. D. MacCaskey, who has been one of the prominent members of the staff of the U. S. Geological Survey for many years, has purchased a ranch near Medford, Ore., and will make his residence there. Mr. MacCaskey will continue to represent the Survey in certain matters pertaining to that section.

Donald M. Liddell is in Texas for ten days on professional business.

Reginald E. Hore, of Toronto, has gone to the Wasapika gold area, where he will examine properties.

Eliot Blackwelder, formerly professor of geology at the University of Illinois, has removed to Denver, Col.

G. B. Richardson has been placed in direct charge of the oil and gas section of the U. S. Geological Survey.

Ray J. Barber is now consulting engineer for the Roxbury Gold Mines, Inc., and is situated in New York City.

George G. Fleming has accepted a position in the testing department of the New Jersey Zinc Co., at Palmerton, Pa.

J. M. Armstrong, of the Caribbean Petroleum Co., has been transferred to Maracaibo, Venezuela, from Philadelphia, Pa.

Bailey C. Clark, consulting engineer for the Atolia Mining Co., was at Loring, Nev., recently in the interest of the company.

H. C. Cook, of the Canadian Geological Survey, is making an investigation of the Larder Lake gold field of Northern Ontario.

Walter Harvey Weed, made a professional examination of the Loring district, Nevada, early in September, for New York clients.

Harry Harper, mining engineer, of Santiago, Chile, has removed to La Paz, Bolivia, where he is connected with W. R. Grace & Co.

Fred Sherman Baker, who has been with the Oriental Consolidated Mining Co., at Unsankinko, Chosen (Korea) is now at Columbia City, Ind.

L. E. Booth, formerly with Anaconda Copper Mining Co., has accepted a position with the Inspiration Consolidated Copper Co., at Inspiration, Ariz.

Frank E. Lathe, of the Chile Copper Co., at Chuquicamata, Chile, has been appointed chief chemist for the British America Nickel Corporation at Sudbury, Ont.

W. O. Hotchkiss, State Geologist of Wisconsin, and **E. R. Butcher** of the Republic Iron & Steel Co., visited the Gogebic Range during the early part of September.

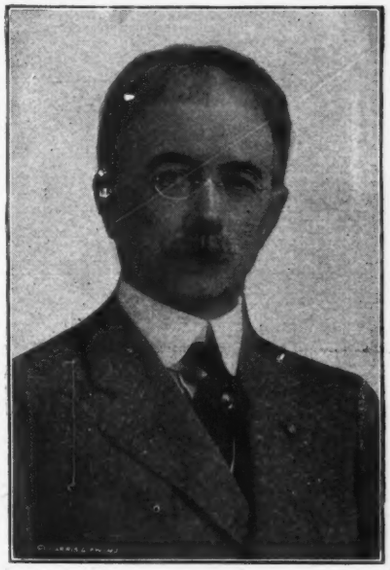
W. H. Gardner, formerly superintendent of the Cyprus mine, at Hibbing, has been appointed superintendent of the McComber mine, on the Vermilion Range.

E. J. Longyear, J. M. Longyear, R. M. Bennett, and **O. B. Warren** have completed the annual inspection of the Bennett-Longyear and Meriden Iron interests on the Mesabi Range.

John D. Ryan and **J. Leonard Replogle** were members of committee of thirteen named by the Secretary of War to meet General Pershing upon his arrival in New York.

Jacob A. Davidson, who made important discoveries in the Matachewan gold area, has been engaged by the Montreal River Gold Mining Co. to examine and report on its holdings.

James F. Rose, of Hibbing, has returned from a reconnaissance survey 250 miles into the wilderness northwest of Ottawa. He was in charge of the work for the Canadian Pacific Ry.



Harris & Ewing

H. D. MACCASKEY

E. J. Lambert and **A. J. Carlson**, professors of the University of Minnesota, have completed an examination of the Mesabi and Vermilion ranges in the in the interest of the Minnesota Tax Commission.

W. C. Phalen, of the Bureau of Mines, left Washington on Sept. 6 for Canada where he will study magnesite deposits around Quebec. Mr. Phalen expects to be back in Washington within three weeks.

John G. Bartram, who is with the Petroleum Co. of Oklahoma, has been transferred from Cheyenne, Wyo., to Tulsa, Okla., to take charge of the geological work of the company in southern Oklahoma.

D. Dale Condit, oil geologist, who has been in the service of the U. S. Geological Survey for several years, has resigned to accept a position with S. Pearson & Sons, Ltd., of London, and has been assigned to work in China and India.

Ernest E. Thum, formerly Western Editor of *Chemical and Metallurgical Engineering*, has been appointed associate editor and is now connected with the New York office. **L. W. Chapman** succeeds Mr. Thum, with offices in San Francisco, Cal.

John W. Allen has resigned as general manager of the mining and transportation department of the Brier Hill Steel Co., Youngstown, Ohio, effective Sept. 6, to accept a position with the National Trading Co., Cleveland. **J. Roscoe Stroh** has succeeded to Mr. Allen's position, the designation of which has been changed to manager of the mining department.

OBITUARY

A. H. Brown, formerly manager of the Hudson Bay mine, Cobalt, and the Dome Lake, at Porcupine, and more lately mining inspector, died recently at Sudbury, Ont., from pneumonia contracted during a visit to the West Shining Tree gold area.

SOCIETIES

Engineers' Club, Houston, Tex., met on Sept. 4, and a paper on the use of lubricating oils at aviation fields was read by W. M. Davis, supervising engineer of the lubricating department of the Texas Co.

Lake Superior Industrial Bureau.—At the annual meeting, the following officers were re-elected: Francis J. Webb, president; W. P. Chinn, vice-president; E. J. Maney, treasurer; and A. F. Ferguson, secretary. Executive committee is composed of F. J. Webb, E. J. Maney, and George D. Swift.

American Society of Civil Engineers announced a meeting to be held on Wednesday, Sept. 17, to be devoted to a discussion on the need for a National Department of Public Works. Among the speakers who were expected to be present were George W. Fuller, Walter D. Blair, M. O. Leighton, and F. J. MacIsaac.

INDUSTRIAL NEWS

The Mine and Smelter Supply Co., Denver, Co., has become agent for the Gardner horizontal and the Gardner-Rix vertical types of air compressors, single and duplex.

The Chicago Pneumatic Tool Co. announces the appointment of Fred Gehbauer, as special navy yard representative, with headquarters at the Philadelphia office, 1740 Market St.

The Inter-State Machinery Corporation, 538 Commercial Trust Building, Philadelphia, Pa., succeeding the Ralph R. Lewis Co., announces it is retaining the same offices and working under the same management as heretofore.

Krogh Pump & Machinery Co., of San Francisco, advises that it has just made a shipment of sand pumps and spare parts to the United Alkalis Co., Liverpool, England, and is receiving a considerable number of foreign inquiries.

The Bucyrus Co., South Milwaukee, Wis., announces that it has opened a Cleveland office at 808 American Trust Building. This office will be in charge of E. G. Lewis, formerly with the New York office of the company, and more recently president of the New Jersey Slag Products Co., Dover, N. J.

The Driver-Harris Co., Harrison, N. J., is now selling its wire-rope products direct to the trade instead of through its former selling agents. The company has increased its facilities to include all grades of rope in 6 x 7, 6 x 12 and 6 x 19 construction, such as drilling cable, elevator and haulage rope, sand lines and similar products in all sizes up to ¾ in.

Williamsport Wire Rope Co., Williamsport, Pa., has established an office and warehouse at Chicago under the direction of C. M. Ballard, formerly connected with the Williamsport organization at Cleveland, Ohio. The Chicago office is at 122 South Michigan Ave., and the warehouse at 755 West Quincy St. The company can now make shipments from Chicago to customers in the territory served from that point.

Worthington Pump & Machinery Corporation announces its purchase of the plant, patterns, accounts, patents, and other assets of the Epping-Carpenter Pump Co., situated at Pittsburgh, Pa. The plant will be operated as the "Epping-Carpenter Works." Orders and contracts now in hand will be completed by the Worthington Pump & Machinery Corporation, and all further business will be for its account. Remittances should be made to and all correspondence should be addressed to the Worthing Pump & Machinery Corporation, at the Epping-Carpenter Works, No. 10 43rd St., Pittsburgh, Pa.

TRADE CATALOGS

Walter A. Zelnicker Supply Co., has issued Bulletin No. 266 containing stock list of supplies in St. Louis, Mo.

Duplex Truck Co., Lansing, Mich., has issued a circular devoted to the interest of motor truck users. Several performances of the company's four-wheel-drive truck are included.

Davis-Bournonville Co., Jersey City, N. J., has issued an illustrated bulletin descriptive of the pyrograph, a boiler-shop cutting machine for trimming and beveling boiler sheets to the correct flange height and calking angle in one operation with oxy-acetylene torch.

Colonial Steel Co., Pittsburgh, Pa., has issued a 25 pp. tool-steel-treating book containing directions for hardening and tempering steel to be used for various purposes. In tabular form are listed various steel products, grade of steel which should be used in their manufacture and drawing color or temperature.

Fireproof Construction, Using Expanded Metal Lath. Northwestern Expanded Metal Co., Old Colony Building, Chicago, Ill.; 6 x 9; 72 pp.; illustrated. Descriptive of the uses of metal lath in construction of partitions and plastering of walls. Stock sizes, weights, and finishes are given in tabular form. Details of construction work with description of lath accessories, viz., channels, corner heads, saddle clips, and others, are included.

NEW PATENTS

U. S. patent specifications may be obtained from the Patent Office, Washington, D. C., at 5c. each.

Alloy of Copper, Nickel, Zinc, Iron, and Manganese. Foster Milliken. (1,314,417, Aug. 26, 1919).

Converter and Smelter. Theodore Miller. (1,314,348, Aug. 26, 1919).

Drill—Rock Drill. Omar E. Clark, assignor to the Denver Rock Drill Maufacturing Co. (1,314,246, Aug. 26, 1919).

Electric Melting Furnace. James D. Shipton. (1,313,746, Aug. 19, 1919).

Flotation—Apparatus for Separating Ore materials From Each Other. Frederick B. Flinn, assignor, by mesne assignments, to Pneumatic Process Flotation Co. (1,314,316, Aug. 26, 1919).

Flotation Processes, oil and feeding device for. William W. Wolcott. (1,314,296, Aug. 26, 1919).

Granulator. Edward N. Greenleaf and George T. Hansen, assignors to Allis-Chalmers Manufacturing Co. (1,309,800, July 15, 1919).

Hose Coupling. N. B. Braly. (1,310,559, July 22, 1919).

Leaching—Apparatus for Extracting Metals From Their Ores. Edmund S. Leaver, assignor of one-half to Charles E. Van Barneveld. (1,312,488, July 5, 1919).

Ore-Concentrating Apparatus. Jacob David Wolf. (1,310,492, July 22, 1919.

Ore-Concentrating Machine. Frederick E. Small. (1,314,370 and 1,314,371, Aug. 26, 1919).

Ore Concentrator. John F. Kellogg. (1,314,335, Aug. 26, 1919).

Phosphoric Acid—Method of and apparatus for producing phosphoric acid and compounds of the same. Frank S. Washburn, assignor to American Cyanamid Co. (1,314,229, Aug. 26, 1919).

Pipe — Corrosion-Resisting Conduit Pipe. Charles Albert Rose and Gustave Monrath, assignors to Chile Exploration Co. (1,310,715, July 22, 1919.)

Pumps—Drainage Valve for Deep-Well Pumps. William H. McKissick. (1,314,070, Aug. 26, 1919.)

Reduction — Ore-Reducing Process. Benjamin Q. P. Foss, assignor to The Foss International Ore Reduction Co. (1,311,645; July 29, 1919.)

Roasting—Method of Roasting Zinc Ores or Concentrates. Urlyn C. Tainton. (1,310,455; July 22, 1919.)

Slag Remover. John H. Abel. (1,303,225; May 13, 1919.)

Smelting and Refining Ore, Process of. Leopold Mambourg, assignor to the Mambourg Continuous Iron and Steel Furnace Co. (1,313,309; Aug. 19, 1919).

Steel, Art of Manufacturing. George Hillard Benjamin. (1,314,384; Aug. 26, 1919.)

Steel, Carbon-Chrome-Nickel. James Ramsey Speer. (1,314,022; Aug. 26, 1919.)

Steel—Production of Refined Basic Steel. William R. Walker. (1,309,162; July 8, 1919.)

Sulphides—Method of Making Soluble Sulphides. Raymond F. Bacon, assignor to Metals Research Co. (1,310,151; July 15, 1919.)

Sulphur—Method of and Apparatus for Sulphur Mining. Robert E. Carmichael. (1,308,929; July 8, 1919.)

Sulphur, Process of Recovery of. Rasik Lal Datta. (1,313,370; Aug. 19, 1919.)

Sulphuric Acid, Contact Process for Making. Herbert Henry Meyers, assignor to Armour Fertilizer Works. (1,314,280; Aug. 26, 1919.)

Tin—Utilization of Tin Scrap. Daniel A. Wilcox and Disney H. Wilcox. (1,310,381; July 15, 1919.)

Washing—Portable Washing Plant. James P. Dovel. (1,309,754; July 15, 1919.)

Welding—Electrode for Electric Arc Welding, Emile Languepin. (1,314,273; Aug. 26, 1919.)

Zinc—Condenser for Zinc Vapors. Sven Huldt, assignor to Norsk Elektrisk Metalindustri Aktieselskap. (1,311,604; July 29, 1919.)

Zinc—Method of Refining Zinc. Sven Huldt, assignor to Norsk Elektrisk Metalindustri Aktieselskap. (1,312,480; Aug. 5, 1919.)

Zinc—Process of Alloying Zinc with Iron or Steel. Benjamin F. Dimm. (1,307,853; June 24, 1919.)

EDITORIAL CORRESPONDENCE

Current Events and Topics in Brief of Interest to Engineers and Operators

NEW YORK, N. Y.—Sept. 12

South American Gold & Platinum Co. has been unable to develop its properties in Colombia as rapidly as it had desired, owing to the failure to settle the dispute over the Panama Canal. The properties comprise 10,000 acres along the San Juan River and about fifty miles of river bed extending up two tributaries of the San Juan, owned by the Pacific Metals Co. The company's mines can be reached in river vessels via the San Juan. The land blocked out, according to the company's estimate, represents about $27,000,000 in platinum and gold. One wooden dredge, with a capacity of 40,000 tons per month, has been working and a new steel dredge will be in operation about Oct. 1. Recently the daily production of the wooden dredge was about $7,000 to $8,000. The company is a holding company for the Anglo-Colombian Mining Co., a British corporation, and the Pacific Metals Co.

BOSTON, MASS.—Sept. 12

The Nevada Consolidated Copper Co. is defendant in a suit brought against it by Minerals Separation North American Corp. and Minerals Separation, Ltd., (British) in the U. S. District Court at Portland, Me. The plaintiffs allege infringement of patents in the concentration of ores, claiming damages and seeking an injunction to prevent further infringement. By bringing suit against Nevada Consolidated, a Maine corporation. Minerals Separation has involved another Federal circuit, the first, as any appeal on the part of Nevada Consolidated would come to Boston for hearing on the adjudication. The Miami company's case went before the third circuit on appeal in Philadelphia. Butte & Superior appeals have been made in the ninth circuit at San Francisco. Prior to this litigation, three suits have been brought by Minerals Separation for patent infringement, two of them against Butte & Superior, which must now make an accounting. In the third case, that against Miami Copper Co., acounting has been taking place for several months.

GRASS VALLEY, CAL.—Sept. 11

Mine Workers' Protective League at a recent meeting in Grass Valley, Cal., decided to enforce rules of the league throughout the district. It was the sense of the meeting that force is to be used, if persuasion fails, to compel workmen who are non-members to join the league. Membership is now between 900 and 1,000. The mines in the district are all running except the Golden Center.

ISHPEMING, MICH.—Sept. 13

The Chemical Plant and ore stock house of the Manistique, Mich., furnace of the Charcoal Iron Co. of America was recently destroyed by fire. The loss is estimated at $150,000. It will be several months before the manufacture of pig iron and chemicals can be resumed there. A few weeks previous one of the buildings of the company's Newberry furnace was burned.

What Effect a Steel Strike will have on the mines of the Lake Superior district it is difficult to predict. The U. S. Steel Corporation has been making heavy shipments of ore throughout the season, evidently anticipating labor troubles. It is believed that some mines will be compelled to close if the furnaces are idle, but the idea of striking is not being taken very seriously in the mining districts. The miners are well satisfied with the wages which they are receiving, and there is no talk of labor troubles on any of the ranges. There is plenty of work, and a miner has no difficulty in getting a place. The sales continue light, although there have been a few inquiries for 1920 delivery.

IRONWOOD, MICH.—Sept. 13

Mine Operators are greatly interested in the impending strike of the steel workers' unions. On the Gogebic Range the unions are not strong, and may not attempt to strike. If steel plants should be forced to close, mines will probably have to do so also, as they already have a surplus stock of ore on hand.

HOUGHTON, MICH.—Sept. 12

Copper has not been moving with any noticeable rapidity from the Michigan ports within the last thirty days. Although there is no large accumulation of stocks on any of the docks, at the same time it is apparent that there has been no insistent demand. Rail shipments are rare.

CLEVELAND, OHIO—Sept. 9

Iron-Ore Shipments from upper Lake ports during August amounted to 4,423,133 gross tons, according to *Iron Age*. This sharp falling off was due to the strike of the dockmen at upper Lake ports, which caused an almost total suspension of the movement for three weeks. The movement during July was 9,173,429 tons, and shipments during August would probably have been about the same had it not been for the strike. The August movement shows a decrease of 5,302,198 tons, as compared with the same month a year ago. The total shipments for the season up to Sept. 1 fell off nearly 10,000,000 tons, as compared with last year, being 29,804,981 tons, as compared with 39,334,264 tons during the same period a year ago. Shipments are now moving forward in fair volume. The amount of ore on the lower Lake docks showed a decrease on Sept. 1, as compared with a month ago. The amount of ore on docks Sept. 1 was 6,705,062 tons, as against 7,069,893 tons Aug. 1. The amount on docks Sept. 1 a year ago was 8,152,214 tons.

TORONTO, ONT.—Sept. 11

John T. Stirling, of the Alberta Department of Mines, states that a force of men in charge of William Pickles, mining engineer, has been sent to Fort McMurray to start drilling for salt, a deposit of which underlies that town. Previous exploration by drilling disclosed a bed 180 ft. deep lying 480 ft. below the surface. It has not been decided whether the government will mine salt or turn the work over to a company. There is an estimated market for about 45,000 tons of salt in Alberta and the adjacent provinces.

Prospectors' Development Co., Ltd., has been incorporated, and plans the organized development of promising mining properties in Northern Ontario. The company is capitalized at $2,000,000, divided into $1 shares. No promotion stock has been issued, the entire stock remaining in the treasury. The following men are identified with the enterprise: John B. Holden, of Toronto; Harry Oakes, president of the Lake Shore mine; H. H. Johnson, of the Tough-Oakes; William Wright, original owner of the Wright-Hargreaves mine; Mr. Bain, of Bicknell, Bain, McDonald & Gordon, and others.

LONDON, ENGLAND—Aug. 23

Organization of the Mexican Corporation has recently been effected by the Camp Bird and Santa Gertrudis companies. Capitalization is £1,000,000. The majority interest is controlled by these two companies, the balance being taken up by the Consolidated Gold Fields, the Consolidated Mines Selection, the Exploration, the Imperial & Foreign Corporation, the Central Mining Corporation, the Lake View group, and the Lena Goldfields companies. The directorate of the new corporation consists of F. W. Baker, chairman of the Camp Bird and Santa Gertrudis companies; R. T. Bayliss, chairman and managing director of the Exploration Company; Lord Brabourne, director of

Consolidated Gold Fields; W. McDermott, chairman of Consolidated Mines Selection Co.; F. A. Govett, chairman of Lake View & Oroya, and Lake View & Star companies; J. A. Agnew, A. S. Elmore, director of Camp Bird and Santa Gertrudis companies; and H. Guedalla, managing director of Imperial & Foreign Corporation and director of Burma Corporation. The company, it is said, has been formed to acquire certain interests in Mexico recommended by the Santa Gertrudis company.

MELBOURNE, AUSTRALIA—July 21

The Moore Filter Co., of the United States, has been granted leave to appeal to the Privy Council, with regard to its unsuccessful action against the Great Boulder Proprietary Gold Mining Co., for an alleged infringement of patent rights.

Hampden-Cloncurry Copper Mines., Ltd., North Queensland, during the half-year ended Feb. 28, operated with a loss of £53,973, to which must be added £12,610, written off for depreciation, making a total debit of £66,583. Curtailed production, consequent upon the stoppage of smelting operations in November last, increased wages and decreased efficiency of labor, and high railway freights were contributing factors to this deficiency. Negotiations for the disposal of the copper unsold are still proceeding. The ore reserves are estimated at 218,000 tons, containing 13,020 tons of copper.

In the Westonia Gold Field, in Western Australia, the local mining warden before whom the drainage action between the Edna May and the Edna May Consolidated was heard, decided in favor of the former. The verdict provided that the Edna May Co. be paid £4,747 for drainage charges up to Apr 1, and £100 per month afterward, with costs. The Edna May Consolidated Co. has also agreed to pay the Edna May Central Co. £400 for past pumping and £50 per month. In the course of a few months the Edna May company will have exhausted its reserves of payable ore and the other companies in the field will have to face the question of fresh arrangements for drainage. Speaking at a recent meeting of the Edna May company, the chairman of directors said that, after negotiation, it had been agreed upon between the two companies to accept the warden's decision as to damages and costs, but payment would be made as follows: £947 to be paid at once (this had been done), on Aug. 1 £100, on Sept. 1 £1,000, the balance, £3,200, to be paid in ten equal monthly installments on the seventh of each consecutive month, in addition to the contribution of £100 per month for current drainage. Costs to be paid when fixed. He also added that the company had decided it would be better expeditiously to extract the profitable ore developed than to operate a portion of the adjoining mine —the Edna Central. For the half year ended Apr. 30 the Edna May company, which is the principal mine on the Westonia field, produced 13,498 tons, averaging £2 9s. 1d. and the recovery by amalgamation was £36,356. Sands and slimes treated yielded £2,819.

THE MINING NEWS

Progress of Mining Operations
Condensed and Classified
for Easy Reference

ARIZONA

Cochise County

Calumet and Arizona (Bisbee)—Smeltery produced 4,814,000 lb. of copper in August, of which 3,438,000 lb. was available for company.

Shattuck Arizona (Bisbee)—Operations (and production) will probably be resumed this month, when pumping will be started. Water, which had filled shaft almost to 700 level, has receded about one-half, or about 55 ft.

Gila County

Old Dominion (Globe)—August production of copper 1,937,000 lb.; July, 1,629,000; August. 1918, 2,064,500.

Inspiration Consolidated (Inspiration)—August production of copper 6,500,000 lb.; July, 6,000,000; August, 1918, 9,000,000.

Miami Copper (Miami)—August production of copper 3,999,120 lb.; July 4,113,452; August, 1918, 5,374,198.

Greenlee County

Arizona Copper (Clifton)—August production of copper 2,900,000 lb.; July 2,400,000; August, 1918, 4,300,000.

Maricopa County

Montezuma (Morristown) — Lessees have taken out about three cars of high-grade lead ore. Property idle for nearly fifteen years. Before that time several cars of rich ore shipped from big gloryhole.

Pima County

New Cornelia (Ajo)—Copper produced in August was 3,066,000 lb. cathodes, 320,000 lb. smelting ore, and 166,000 cement copper.

Pinal County

Red Hills (Price)—Shipping carbonate ores from recent development. Plan to resume drilling at early date.

Ray Consolidated (Ray)—Production of copper in August, 3,895,000 lb.; July, 3,865,000.

Potts Canyon (Superior)—Development resumed, having been suspended during war. Sinking new shaft. Ores carry silver, lead, and vanadium. W. E. Defty in charge.

Yavapai County

U. V. Extension (Jerome)—August production of copper 3,275,452 lb., or over 300,000 lb. less than in July. Reduction caused by changing from blast furnace to reverberatory and also to labor shortage.

Sheldon Mining (Walker)—Company planning extensive development work under direction of Mark Bradley. New compressor and other equipment will be installed.

CALIFORNIA

Amador County

Bunker Hill Cons. (Amador City)—Levied assessment of 5c. per share to continue development below 2,800 level.

Eldorado County

Melton (Placerville)—J. Q. Wrenn, of Placerville, bought half interest in Eagle King gold quartz mine, better known as Melton mine, situated fifteen miles east of Placerville.

Nevada County

At Bullard's Bar, forty men working under George F. Taylor placing concrete foundation for restraining dam in Yuba River. Work being rushed.

Empire (Grass Valley)—Continuous pumping in this and North Star mines has reduced flow to normal. Work resumed in latter on 6,300 level.

Golden Center (Grass Valley)—Pulled pumps Sept. 5 and will shut down as soon as mill treats ore on hand, owing to high costs and uncertain labor market. Stockholders authorized sale of 187,000 shares of treasury stock at $1 per share to provide fund for possible future operation.

Tulare County

Blue Mountain (Porterville)—Reported purchased by directors of Golden Center mine. of Grass Valley.

Tuolumne County

Black Oak (Soulsbyville)—Development begun on 1,800 level. North drift will be driven 300 ft.

COLORADO

Garfield County

Champion Oil Shale & Refining (Grand Valley)—Orders placed in Denver for shale plant. N. W. Bansill and M. Mulling, of Las Vegas, N. M., chief

stockholders and directors, recently in Grand Valley to confer with J. L. Herrick, manager.

La Plata County

Cumberland (Durango)—Shaft being sunk, to be about 500 ft. deep, to develop Cumberland vein below Red Bed formations. E. B. Miller consulting engineer.

Mineral County

Melissa (Creede)—Leary, Campbell & Co., lessees of Melissa claim on Bachelor Mountain, have opened up oreshoot on "Top Blanket Vein." Plans completed for building mill and aerial tramway.

Pitkin County

Oakland (Aspen)—Alexander and Martin Scott, operating Oakland mine on south side of Queen's Gulch four miles south of Aspen, discovered high-grade silver-bearing ore in vein 9 ft. wide. Said to include streak few inches wide of solid polybasite. Oakland developed in early days by tunnel several hundred feet long. Several small "feeders" cut in driving this tunnel, but were not prospected. Much activity has resulted in Aspen district.

San Juan County

Silver Lake (Silverton)—Leased to John Giomp, of Silverton. Several groups of lessees and sub-lessees already at work. Shipping to Iowa Tiger mill.

Summit County

Molly B (Breckenridge)—Will resume operations at copper-bismuth-silver mine in Yuba Dam Flats section. H. F. Sandy will be in charge.

Wellington Mines (Breckenridge)—Resumed operations Sept. 2. Is heaviest producer of zinc lead ores in district.

MICHIGAN

Copper District

Allouez (Allouez)—Operating two shafts and will reach normal production within month. Using ten electric motors.

Calumet & Hecla (Calumet)—Have added 500 men to force in last three months.

Seneca (Calumet)—Total of 325 ft. opened in lode both sides from shaft. North side in good copper from start. South side ran into fissure characteristic of Kearsarge amygdaloid but good ground found again. Stockpiling rock from first level to be milled to prevent accumulation as soon as there is enough to keep one head running two shifts. Three sites considered for proposed mill.

Winona (Houghton) — Increasing working force, which now totals 140 men. Former employees returning from manufacturing centers. Stamp mill running. Mining from one shaft. Second shaft expected to be in operation in thirty days.

Copper Range (Painesdale)—Baltic mine producing rock running 34 lb. per ton and Trimountain 30-31 lb. per ton. Continuing to select rock underground.

Gogebic Range

Aurora (Ironwood)—Change house about completed. Will accommodate 400 men. Built of concrete blocks, one story, 138 x 40 ft. Roof of concrete on hy-rib with air space and plaster inside. Steel lockers, 20 x 15 in., in central portion, with wash sinks along side walls, and six showers and toilet room at each end of building. Small basement at one end contains coal bin and two boilers, one for steam heat, other for heating water. Similar change houses are under construction at Norrie and Pabst mines.

Pabst (Ironwood) — At H shaft, engine-house foundations built, and foundation for one hoist ready. Next week work will begin on conduit transmission line from there to G power house. Cables will be in fibre conduits laid in concrete.

MINNESOTA

Mesabi Range

Hobart (Gilbert)—Will start shipping again this fall. Originally opened in 1907, but abandoned after small shipment. Fee owned by Murphy-Dorr-Flinn interests. Recently leased to M. A. Hanna & Co., which has overcome many obstacles in getting property in condition. Large volume of water in development and swampy nature of surface of particular annoyance.

Wade-Helmer (Kinney) — Stripping of portion of Wade, adjoining old pit of Helmer, has progressed to clean-up stage. Sixty-ton shovel engaged in clean-up; revolving shovel in bottom loading dump cars, which are hoisted on skipway and transferred to railroad cars. Wade is North Star lease, Helmer fee owned by state. Cleveland-Cliffs Iron Co. operators.

MONTANA

Deer Lodge County

Southern Cross (Anaconda) — Sinking under way, with heavy volume of water.

Missoula County

Potomac Copper (Potomac)—Arrangements concluded for power line from C. M. & St. P. road, eleven miles away, to property. Installation of air compressor plant to be completed soon.

Powell County

Monarch (Elliston)—Tramway over 1,700 ft. long being constructed to carry ore down mountain side.

Silver Bow County

Anaconda (Butte)—Copper production for August, 12,600,000 lb.; July, 11,122,000 and June, 10,530,000.

Butte & Ramsdell (Butte)—First dividend expected this month.

Butte Bullwhacker (Butte)—Shipments begun to Anaconda leaching plant at Washoe works.

Butte New England (Butte)—Operations suspended, and negotiations under way with Hayden-Stone interests for acquiring property, which adjoins Davis-Daly.

Davis-Daly (Butte)—Tonnage for Colorado mine in August, 144 cars; July, 90. Net earnings for August over $140,000, against $92,000 in July. Tonnage being increased.

Elm Orlu (Butte)—Proving-up in connection with controversy with Anaconda company, which is mining ore in portion of Emily vein in Pilot-Butte mine. Elm Orlu claims title because vein uniting with Emily apexes inside Elm Orlu, a prior location over Emily or Pilot-Butte claims.

Tuolumne (Butte)—Crosscut on 1,000 level of Main Range mine has cut ore in Spread Delight fissure. Sinking continuing to 1,200 level, where Spread Delight will be crosscut again.

NEVADA

Clark County

Boss Gold (Goodsprings) — Semi-annual report shows net amount received from two cars of platinum-palladium ore was $15,038.70. Two cars of copper ore also shipped during half year.

Lincoln County

Hamburg (Pioche)—Work soon to be resumed on company account. No leases to be let, though several applications received.

Black Metals (Pioche)—New machinery recently installed working smoothly, according to George Snyder, manager. Increased production assured.

Mineral County

Simon Fagan (Mina)—Shaft still in good ore, with gold and lead increasing and silver decreasing. E. S. Chafey manager.

Nye County

White Caps (Manhattan) — Gross production for August about $26,000. Ore recently discovered beyond fault on 600 level.

Cons. Spanish Belt (Manhattan)—East heading on Ernst vein on main tunnel level advanced 22 ft. Face shows 5 ft. of good ore.

Pershing County

Nevada Valleys Power (Lower Rochester)—Again able to furnish mines and mills of Rochester district with abundance of power owing to lessened use of water by ranchers. Companies at Lower Rochester and Packard preparing to resume operations with full force.

White Pine County

Nevada Consolidated (McGill)—No copper production reported for August on account of strike.

NEW MEXICO

Grant County

Chino Copper (Santa Rita)—Copper production in August, 3,321,857 lb.; July, 3,626,354.

OREGON

Baker County

Ben Harrison (Baker)—Plans to enlarge mining plant in Greenhorn district and install flotation system. W. C. Fellows, general manager.

UTAH

Juab County

Tintic Drain Tunnel (Eureka)—Power line being strung, and work to be started on air shaft as soon as line completed. Good progress made in driving tunnel. Henry Barney in charge.

Tintic Standard (Eureka)—Railroad to mine expected to be completed middle October.

Salt Lake County

Alta Tunnel & Transportation (Alta)—Has found mineralization at 1,400 ft. depth below old Prince of Wales workings. New find thought to be in Prince of Wales fissure.

Montana Bingham (Bingham Canyon)—During August, fourteen cars shipped bringing net returns of $20,921. Drifting from tunnel on Fortuna and Mayflower veins, latter furnishing most of ore for present shipments. Old Highland Boy ore bins in D. & R. G. yards at Bingham purchased, and to be moved to portal of Montana-Bingham tunnel, to give additional bin capacity of 250 to 300 tons.

Utah Copper (Salt Lake City)—Copper production in August, 8,640,000 lb.; July, 8,405,863.

Summit County

Park City Shipments week ended Sept. 6 were 3,623,480 lb. ore and concentrates. Shippers: Silver King Coalition, 1,200,000 lb., Ontario Silver, 1,009,000; Judge M. & S., 1,005,000; Daly West, 408,110.

Keystone Mining (Park City)—Proposed to increase caupitalization from 700,000 shares to 1,000,000 shares, par value $1, with view to procuring funds for further development.

Naildriver (Park City)—Compressor to be installed soon. Developing with view to opening more ore before making further shipments.

Park-Utah (Park City)—Work resumed with twenty men. Developing new territory in eastern section of camp, working from Ontario drain tunnel.

WASHINGTON

Stevens County

United Silver-Copper (Chewelah)—Shipped eleven cars of ore in August, also seven cars flotation concentrates, one car table concentrates carrying 20 per cent copper and 80 oz. of silver, and 3 cars of high-grade crude ore. Raise from 1,000 level driven 165 ft. and connection made, which enables removal of large block of milling ore. Ten-foot orebody disclosed 600 ft. north of main drift on 1,200-ft. level. Mill tonnage increased to 175 daily. Eighty-seven men are employed in mine and mill.

Northport S. & R. (Northport)—Suspension of smelting operations on account of labor strike in Coeur d'Alenes district has permitted plant improvements. Furnaces being relined. About fifty men employed.

Okanogan County

Copper World Extension (Nighthawk)—Property located on Palmer Mountain. Have completed installation of Riblet tramway and are carrying on development work while awaiting favorable smelting conditions for heavy sulphide ore.

Pyrargyrite (Oroville)—Property well developed. Clearing ground for erection of 50-ton mill to treat silver ore. Tables and flotation will be used. Monroe Harmon, manager.

CANADA

British Columbia

Dolly Varden (Alice Arm)—Taylor Engineering Co. will extend railroad four miles next year to aid other properties, according to Dr. King, Minister of Public Works. Dolly Varden producing 100 tons ore daily and shipping regularly to Anyox.

British Columbia Manganese (Duncan)—Shipped two cars of ore from properties at Hill 60. Will ship regularly.

Rock Candy (Grand Forks)—Consolidated M. & S. Co. installing three additional decrepitating furnaces and rotary kilns at fluorspar property near Lynch Creek, near Grand Forks. Furnace and kiln already installed satisfactory. Four units when complete will handle 100 tons daily. A. A. Robertson in charge.

Hedley Gold (Hedley)—Will close mill this fall, on account of high wages and cost of supplies. Present surplus will be used for continuing mine development instead of paying dividends.

Mountain Chief (Renata)—Shipping 200 tons, of which much is bornite.

Noble Five (Slocan) — Syndicate composed of James Dunsmuir, of Victoria, and associates is building concentrator at Cody.

Panama (Slocan)—H. Giegerich, now sole owner, has resumed work. Tunnel in 370 ft.

Ruth (Slocan)—Eight-foot vein cut 600 ft. from portal of tunnel.

Ontario

Peerless (Boston Creek) — Shaft down 150 ft. Lateral work will be undertaken when 200 level is reached.

Bourkes (Bourkes Station)—Shaft being sunk 200 ft. below level. New 12-drill air compressor ready for operation.

Tucker-Welsh Claims (Larder Lake)—Nipissing sampling this property.

Clifton Porcupine (Porcupine) — Boulder vein opened up for 160 ft. on first level. Crosscut being driven to connect with No. 7 vein. Installation of electrical equipment nearing completion.

Dome Extension (Porcupine)—Now completing fourth crosscut into orebody on 600 level. In one crosscut thought to be at widest part of ore body 99 ft. was cut. Stoping under way.

Dome Lake (Porcupine) — Shareholders ratified by-law for $100,000 bond issue.

Keora (Porcupine)—Diamond drilling completed. Planned to sink to high-grade orebody indicated by drilling.

Porcupine Crown (Porcupine)—All underground workings dewatered and operations under way to 1,000 level.

McIntyre (Timmins)—About 800 ft. of No. 5 vein opened up on 1,100 level; showing higher gold content than on upper levels. Below 1,000 ft. formation changes, quartz decreasing and being replaced by sulphides, which necessitates finer grinding. Tube mill being installed. On Plenaurum heavy flow of water struck on 1,000 level, rendering deep mining difficult.

MEXICO

Jalisco

Numerous Sales of Properties reported as follows: Cuale mines to Esperanza Mines Co. of El Oro; Lupita mines to Mexico Mines of El Oro; Saturno mines to Dos Estrellas Mining Co. of El Oro; San Pedro Analco mine to San Rafael y Anexas Co.; Guachinango mine to American Metals Co.; Mazata mine to Carlos Romero and a French company which is installing 150-ton cyanide plant; Noce Bueno and Virrey mines to Cia. Real del Monte at Pachuca.

AUSTRALIA

Broken Hill Prop. (Broken Hill)—Head office in Melbourne has announced shipping strike has ended.

BRAZIL

St. John del Rey (Morro Velho)—Gold production first half August £16,500; yield per ton 47s. 2d.

KOREA

Oriental Consolidated (Unsan)—August clean-up $62,500. Taracol operations suspended seventeen days, owing to scarcity of water. Now in full operation. Completion of Suribong power project delayed by failure of Pelton turbines to arrive.

TRANSVAAL

Rand Gold Output in August 706,000 oz.; July 725,000.

Market Report for Sept. 20 Will Appear In Issue Of Sept. 27

Industrial conditions in New York have made it expedient to close the forms of the *Journal* in advance of the routine schedule date. The usual market quotations are therefore necessarily omitted from this number. The market pages which would have appeared normally in the Sept. 20 issue will be published in the *Journal* of Sept. 27.

CURRENT PRICES — MATERIALS AND SUPPLIES

IRON AND STEEL

SHEETS—Quotations are in cents per pound in various cities from warehouse also the base quotations from mill:

Blue Annealed	Large Mill Lots Pittsburgh	St. Louis	Chicago	San Francisco	New York — Current	New York — One Yr. Ago
No. 10	3.55	4.64	4.57	5.80	4.57	5.50
No. 12	3.60	4.69	4.62	5.75	4.62	5.55
No. 14	3.65	4.74	4.67	5.90	4.67	5.60
Black						
Nos. 18 and 20	4.15	5.24	5.42	6.75	5.30	6.30
Nos. 22 and 24	4.20	5.29	5.47	6.80	5.35	6.35
No. 26	4.25	5.34	5.52	6.95	5.40	6.40
No. 28	4.35	5.44	5.62	7.05	5.50	6.50
Galvanized:						
No. 10	4.70	5.79	5.97	....	6.20	6.85
No. 12	4.80	5.89	6.07	7.30	6.25	6.95
No. 14	4.80	5.89	6.07	7.30	6.30	6.95
Nos. 18 and 20	5.10	6.19	6.37	7.60	6.60	7.25
Nos. 22 and 24	5.25	6.34	6.52	7.75	6.75	7.30
No. 26	5.40	6.49	6.67	7.90	6.90	7.45
No. 28	5.70	6.79	6.97	8.20	7.20	7.75

STEEL RAILS—The following quotations are per gross ton f.o.b. Pittsburgh and Chicago for carload or larger lots. For less than carload lots 5c. per 100 lb. is charged extra·

	Pittsburgh — Current	Pittsburgh — One Year Ago	Chicago — Current	Chicago — One Year Ago
Standard bessemer rails	$45.00	$65.00	$45.00	$65.00
Standard openhearth rails	47.00	67.00	47.00	67.00
Light rails, 8 to 10 lb	2.58½*	3.36*	2.83½*	3.36½*
Light rails, 12 to 14 lb	2.54*	3.09*	2.79*	3.09*
Light rails, 25 to 45 lb	2.45*	3.00*	2.70*	3.00*

* Per 100 lb.

TRACK SUPPLIES—The following prices are base per 100 lb. f.o.b. Pittsburgh for carload lots, together with the warehouse prices at the places named·

	Pittsburgh — Current	Pittsburgh — One Year Ago	Chicago	St. Louis	San Francisco
Standard rai road spikes, ⅝-in. and larger	$3.35	$3.90	$4.27	$4.44	$5.65
Track bolts	4.35	4.90	5.17	Premium	6.65
Standard section angle bars	3.00	3.25	4.22	Premium	4.60

STRUCTURAL MATERIAL—The following are the base prices f.o.b. mill, Pittsburgh, together with the quotations per 100 lb. from warehouses at the places named:

	Mill Pittsburgh	New York — Current	New York — 1 Yr. Ago	St. Louis	Chicago
Beams, 3 to 15 in.	$2.45	$3.47	$4.245	$3.54	$3.47
Channels, 3 to 15 in.	2.45	3.47	4.245	3.54	3.47
Angles, 3 to 6 in., ¼ in. thick	2.45	3.47	4.245	3.54	3.47
Tees, 3 in. and larger	2.45	3.52	4.245	3.54	3.47
Plates	2.66	3.67	4.495	3.54	3.67

STEEL SHEET PILING—The following price is base per 100 lb. f.o.b. Pittsburgh, with a comparison of a month and a year ago:

Current	One Month Ago	One Year Ago
$2.55	$2.55	$4–5

RIVETS—The following quotations are per 100 lb.:

	Mill Pittsburgh	New York — Current	New York — One Year Ago	Chicago	St. Louis	San Francisco	Dallas
	STRUCTURAL — Warehouse						
½-in. and larger	$4.20	$4.72	$5.65	$4.72	$4.79	$6.05	$7.50
	CONE HEAD BOILER						
½ in. and larger	4.30	4.82	5.75	4.82	4.89	6.15	7.—
⅜ and 7/16	4.45	4.97	5.90	4.97	5.04	6.30	7.50
⅜ and 9/16	4.70	5.22	6.25	5.32	5.29	6.65	7.75

Lengths shorter than 1 in. take an extra of 50c. Lengths between 1 in. and 2 in. take an extra of 25c.

WIRE ROPE—Discounts from list price on regular grades of bright and galvanized are as follows:

	New York and St. Louis
Galvanized iron rigging	+12½%
Galvanized cast steel rigging	7½%
Bright plow steel	35%
Bright cast steel	22½%
Bright iron and iron tiller	5%

HORSE AND MULE SHOES—Warehouse prices per 100 lb. in cities named:

	Mill Pittsburgh	Cincinnati	Chicago	St. Louis	Denver	Birmingham
Straight	$5.75	$7.50	$6.50	$6.25	$8.50	$7.35
Assorted	.....	7.50	6.50	6.40	8.75	7.60

BAR IRON AND STEEL—Per pound to large buyers at mill, Pittsburgh:

Iron bars.....2.75c. Steel bars..... 2.35c.

COAL BIT STEEL—Warehouse price per pound is as follows:

New York	Cincinnati	Birmingham	St. Louis	Denver	Chicago
$0.12	$0.16½	$0.18	$0.19	$0.18½	$0.14½

DRILL STEEL—Warehouse price per pound:

	New York	St. Louis	Birmingham	Denver
Solid	12c.	13c.	15c.	15c.
Hollow	18c.	14c.	...	20c.

STEEL AND IRON PIPE—The following discounts are for carload lots f.o.b. Pittsburgh, basing card of National Tube Co. for steel pipe, Cardry A. M. Byer's for iron, both dated Mar. 21, 1919.

Inches	Steel Black Per Cent.	Steel Galvanized Per Cent.	Inches	Iron Black Per Cent.	Iron Galvanized Per Cent.
	BUTT WELD				
⅛ to 3	57½	44	⅛ to 1¼	39½	23½
	LAP WELD				
2	50½	38	1½	24½	9½
2½ to 6	53½	41	1½	31½	17½
7 to 12	50½	37	2	32½	18½
13 and 14	41	..	2½ to 6	34½	21½
15	38½	..	7 to 12	31½	18½
	BUTT WELD, EXTRA STRONG PLAIN ENDS				
⅛, ¼ and ⅜	46½	29	⅛, ¼ and ⅜	28½	11½
½	51½	39	½	33½	20½
¾ to 1¼	55½	43	¾ to 1¼	39½	24½
2 to 3	56½	44			
	LAP WELD, EXTRA STRONG PLAIN ENDS				
2	48½	37	1½	25½	10½
2½ to 4	51½	40	1½	31½	17½
4½ to 6	50½	9	2	33½	20½
7 to 8	46½	33	2½ to 4	35½	23½
9 to 12	41½	28	4½ to 6	34½	22½
			7 to 8	26½	14½
			9 to 12	21½	9½

From warehouses at the places named the following discounts hold for steel pipe.

	Black — New York	Black — Cleveland	Black — Chicago
⅛ to 3 in. butt welded	47%	43½%	57½%
3½ to 6 in. lap welded	42%	45½%	53½%
	Galvanized — New York	Galvanized — Cleveland	Galvanized — Chicago
⅛ to 3 in. butt welded	31%	34½%	44%
3½ to 6 in. lap welded	27%	30½%	41%

Malleable fittings, Class B and C, from New York stock sell at list plus 12½% Cast iron, standard sizes, 10%.

NUTS—From warehouse at the places named, on fair-sized orders, the following amount is deducted from list:

	New York — Current	New York — One Year Ago	Cleveland — Current	Cleveland — One Year Ago	Chicago — Current	Chicago — One Year Ago
Hot pressed square	$1.50 + 2.50		$2.25	$1.20	$1.85	$1.05
Hot pressed hexagon	1.50 + 2.50		2.25	1.00	1.85	.85
Cold punched square	1.50 + 2.50		2.25	.75	1.30	1.00
Cold punched hexagon	1.50 + 2.50		2.25	.75	1.30	1.00

Semifinished nuts sell at the following discounts from list price:

	Current	One Year Ago
New York	50–10–75%	50%
Chicago	50%	50%
Cleveland	60–10%	50%

MACHINE BOLTS—Warehouse discounts in the following cities:

	New York	Cleveland	Chicago
⅜ by 4 in. and smaller	50%	50%	50–5%
Larger and longer up to 1 in. by 30 in.	40%	40%	40–5%

WASHERS—From warehouses at the places named the following amount is deducted from list price:

For wrought-iron washers:
New York..... $1.25 Cleveland..... $3.75 Chicago..... $3.00
For cast-iron washers the base price per 100 lb. is as follows:
New York..... $6.00 Cleveland..... $3.75 Chicago..... $4.25

CONSTRUCTION MATERIALS

ROOFING MATERIALS—Prices per ton f.o.b. New York and Chicago:

	Carload Lots N. Y.	Carload Lots Chicago	Less Than Carload Lots N. Y.	Less Than Carload Lots Chicago
Tar felt (14 lb. per square of 100 sq.ft.)	$60.00	$60.50	$61.00	$61.50
Tar pitch (in 400-lb. bbl.)	21.00	18.00	22.00	19.00
Asphalt pitch (in barrels)	34.00	34.00	37.50	37.50
Asphalt felt	63.00	63.00	67.50	67.50

PREPARED ROOFINGS—Standard grade rubbered surface, complete with nails and cement, costs per square as follows in New York, St. Louis, Chicago and San Francisco:

	1-Ply — c.l.	1-Ply — l.c.l.	2-Ply — c.l.	2-Ply — l.c.l.	3-Ply — c.l.	3-Ply — l.c.l.
No. 1 grade	$1.50	$1.75	$1.90	$2.15	$2.30	$2.55
No. 2 grade	1.35	1.60	1.70	1.95	2.05	2.30

Asbestos asphalt-saturated felt (14 lb. per square) costs $156 per ton.

Slate-surfaced roofing (red and green) in rolls of 108 sq.ft. costs $2.25 per roll in carload lots and $2.50 for smaller quantities.

Shingles, red and green slate finish, cost $6.00 per square in carloads, $6.25 in smaller quantities, in Philadelphia.

HOLLOW TILE—

	4x12x12	8x12x12	12x12x12
St. Paul	$0.056	$0.11	$0 162
Seattle	.09	.175	.30
Los Angeles*	.082	.154	.236
New Orleans	.165	.22	.325
Cincinnati	.078	.104	.....
Birmingham	.072	.135	.....
St. Louis	.08	.15	.....

* F. o. b. factory, 4, 8 and 10 inch.

LUMBER—Price per M in carload lots:

	8 x 8-In. x 20 Ft. and Under			12 x 12-In. 20 Ft. and Under	
	P.	Fir	Hemlock	Spruce	P.	Fir
Boston	$50.00	$49.00	$48.00	$48.00	$50.00	$50.00
Kansas City	51.00	51.25	51.25	.....	57.00	48.50
Seattle	.....	30.00	.....	.....	.....	31.00
New Orleans	45.00	.....	.....	.....	48.00	.....
St Paul	60.00	61.00	60 00	46.00	62.00	63 00
Atlanta	55.50	57.50	58.00	68.00	68.50	70 50

	1-In. Rough, 10 In. x 16 Ft. and Under			2-In. T. and Gr. 10 In. x 16 Ft.	
	P.	Fir	Hemlock	P.	Fir
Boston	$50.00	$50.00	$48.00	$50.00	$50.00
Kansas City	78.50	64.75	64 75	81.75	77.75
Seattle	.....	31.50	.....	.....	31.50
New Orleans	54.00	.....	.....	55.25	.....
St. Paul	58.00	55.00	54 00	63.00	56.00
Atlanta	80.00	85.00	.....	65.00	67.50

* 2x8 costs $56. † Up to 32 ft., above that add $4. ‡ Also tamarac.
Los Angeles—Base price (2x3x16 ft.), Douglas fir or hemlock, $43.
Detroit—Base price, yellow pine (8x8x20), $43.

NAILS—The following quotations are per keg from warehouse:

	Mill Pittsburgh	St. Louis	Dallas	Chicago	San Francisco
Wire	$3.25	$3.90	$5.00	$3.90	$5.00
Cut	4.925	5.40	6.40	5.00	6.65

PORTLAND CEMENT—These prices are for barrels in carload lots, without bags.

	Current	One Month Ago	One Year Ago with Bags
New York	$2 30	$2.30	$2.50
Jersey City	2.27	2.27	2 50
Boston	2.42	2.42	2.87
Chicago	2.00	2.00	2.90
Pittsburgh	2.05	2.05	2.71
Cleveland	2 32	2.32	2 15
Denver	2.67	2.67	3.07

Note—Charge for bags is generally 15c. each, 60c. per bbl.

LIME—Warehouse prices:

	Hydrated per Ton		Lump per 300-Lb. Barrel	
	Finished	Common	Finished	Common
New York	$17.50	$14.50	$2.90	$2.65
Kansas City	22.00	21.00	2.30	2.20*
Chicago	18.00	17.50	1.80*	1.10*
St. Louis	.....	18.00	.....	1.75*
Boston	22.75	18.25	3.65	3.30
Dallas	2.25*	1.25*	.....	.....
San Francisco	19.00	.....	.....	2.00*
St Paul	23.00	20.00	1.60*	1.50*
New Orleans	.....	10.00	.....	11.00‡
Atlanta	.....	1.90*	1.75*	1.75*
Denver	20.00	20.00	.....	2.15‡

* 200-lb. barrels. † Per 180-lb. bbl. ‡ Per ton.
Note—Refund of 10c. per barrel.

LINSEED OIL—These prices are per gallon:

	New York		Cleveland		Chicago	
	Current	One Year Ago	Current	One Year Ago	Current	One Year Ago
Raw per barrel (5 bbl. lots)	$2.15	$1.90	$2.50	$2.10	$2.37	$2.05
5-gal. cans	2.30	2 00	2.75	2.25	2.57	2.25

WHITE AND RED LEADS—in 500-lb. lots sell as follows in cents per pound:

	Red				White	
	Current		1 Year Ago		Current	1 Yr. Ago
	Dry	In Oil	Dry	In Oil	Dry and In Oil	Dry and In Oil
100-lb. keg	13.00	14 50	14.00	14 50	13.00	14.00
25- and 50-lb. kegs	13.25	14.75	14.25	14 75	13 25	14.20
12½-lb. keg	13 50	15.00	14.50	15 00	13.50	14 50
5-lb. cans	15.00	16.50	.....	.....	15.00	16.00
1-lb. cans	16.00	17.50	.....	.....	16.00	17.00

MINING AND MILLING SUPPLIES

HOSE—

	Fire	50-Ft. Lengths
Underwriters' 2½-in		75c. per ft.
Common, 2½-in		40%

	Air		
	First Grade	Second Grade	Third Grade
¼-in per ft	$0.50	$0.33	$0.22

Steam—Discounts from List

First grade..... 30% Second grade..... 40% Third grade..... 45%

LEATHER BELTING—Present discounts from list in the following cities are as follows:

	Medium Grade	Heavy Grade
New York	45%	35%
St. Louis	40%	35%
Chicago	45%	40%
Birmingham	35%	30%
Denver	35–5%	30%
Cincinnati	30–5–2½%	40–2½%

RAWHIDE LACING—30% off for cut; 62c. per sq ft. for side lacing.

MANILA ROPE—For rope smaller than ½ in. the price is ½ to 2c. extra; while for quantities amounting to less than 600 ft there is an extra charge of 1c. The number of feet per pound for the various sizes is as follows: ⅜-in., 8 ft., ½-in., 6; ⅝-in., 4½; ¾-in., 3½; 1-in., 2 ft. 10 in.; 1¼-in., 2 ft. 4 in. Following is price per pound for ⅜ in and larger, in 1200-ft. coils.

Boston	$0.25	Denver	$0.27½
New York	.27	Kansas City	.27
Cincinnati	.29	New Orleans	.25½
Chicago	.26½	Seattle	.25
St. Paul	.28	St Louis	.26½
San Francisco	.24	Atlanta	.29½

PACKING—Prices per pound:

Rubber and duck for low-pressure steam	$0.90
Asbestos for high-pressure steam	1.50
Duck and rubber for piston packing	1.00
Flax, regular	1.20
Flax, waterproofed	1.60
Compressed asbestos sheet	.90
Wire insertion asbestos sheet	1.10
Rubber sheet	.50
Rubber sheet, wire insertion	.70
Rubber sheet, duck insertion	.50
Rubber sheet, cloth insertion	.30
Asbestos packing, twisted or braided and graphited, for valve stems and stuffing boxes	1.20
Asbestos wick, ½- and 1-lb. balls	.85

REFRACTORIES—Following prices are f. o. b. works:

Chrome brick	net ton	$90–1.00	at Chester, Penn.
Chrome cement	net ton	45–50	at Chester, Penn.
Clay brick, 1st quality fireclay	net ton	35–45	at Clearfield, Penn.
Clay brick, 2nd quality	net ton	30–35	at Clearfield, Penn.
Magnesite, dead burned	net ton	32.50	at Chester, Penn.
Magnesite brick, 9 x 4½ x 2½ in	net ton	80–90	at Chester, Penn.
Silica brick	net ton	41–45	at Mt. Union, Penn.

Standard size fire brick, 9 x 4½ x 2½ in. The second quality is $4 to $5 cheaper per 1000.

St. Louis—Fire Clay, $30 to $40.

Birmingham—Fire clay, $41–$44; silica, $46.50-$54.50; magnesite, $80–$85; chrome, $80 to $90.

Chicago—Second quality, $25 per ton.

Denver—Silica is $35 per 1000.

RAILWAY TIES—For fair size orders, the following prices per tie hold:

	Material	7 In. x 9 In. by 8 Ft. 6 In.	6 In. x 8 In. by 8 Ft.
Chicago	Plain	1.48	1.33
San Francisco	Douglas Fir—Green	1.42	1.00
San Francisco	Douglas Fir—Creosoted	2.12	2.00

Prices per tie at Missouri mills; St. Louis prices about 25c. higher:

Untreated A Grade White Oak 6x8x8		Untreated A Grade Red Oak 6x8x8	
No. 1	$0.70	No. 1	$0.55
No. 2	.80	No. 2	.65
No. 3	.90	No. 3	.75
No. 4	.98		
7x9x8 white oak	1.05		
7x9x8 red oak, No. 4	.80	No. 5	.87

FLOTATION OILS—Prices of oils for flotation, in cents per gallon, in barrels

	New York	Chicago In Bbl.	Chicago Carloads	Denver
Pure steam-distilled pine oil, sp.gr. 0.925-0.94	$0.78	$1.05	$1.00	$ 0.85
Pure destructively distilled pine oil	.68	.95	.90	.85
Pine tar oil, sp.gr. 1.02—1.035	.45	.36	.34	.55–.60
Crude turpentine	.72	.68	1.68	.30
*Hardwood creosote, sp.gr. 0.96–0.99	1.73	.....	.....	.25–.30

* F.o.b. Cadillac, Mich,

COTTON WASTE—The following prices are in cents per pound:

	New York			
	Current	One Year Ago	Cleveland	Chicago
White	13.00	11.00	14.00	11.00 to 14.00
Colored mixed	9.00 to 12.00	8.50–12.00	11.00	9.50 to 12 00

WIPING CLOTHS—Jobbers' price per 1000 is as follows:

	13½x13½	13½x20½
Cleveland	$52.00	$58.00
Chicago	41.00	43.50

EXPLOSIVES—Price per pound of dynamite in small lots and price per 25 lb. keg for black powder

	Low Freezing 20%	Gelatin 40%	Gelatin 60%	Gelatin 80%	Black Powder
New York	.....	$0 27½	$0.30	.....	$2.40
Boston	$0.22½	.24½	.26½	$0.31	2.20
Cincinnati	.19½	.21½	.23½	.....	2.25
Kansas City	.19	.23½	.26½	.30	2.45
New Orleans	.....	.22½	.24½	.....	.....
Seattle	.14½	.18½	.25½	.31½	1.90
Chicago	.18½	.21½	.25½	.29½	2.15
St Paul	.19	.23½	.26½	.....	2.45
St. Louis	.19	.23½	.25½	.30	2.40
Denver	.17½	.22	.24½	.28½	2.25
Dallas	.189	.225	.228	.342	.....

CHEMICALS

SODIUM CYANIDE—New York price is 31c. per lb.; Denver, 37c.; Chicago, 31½c.; St Louis, 31c.

SODIUM SULPHIDE—In New York the price per pound is .05c. for concentrated, 3c. for crystals. The St. Louis price is 5c. for concentrated. The Denver price is 7½c. for crystals. The Chicago price is 5c. for concentrated, 3c. for crystals. Concentrated comes in 500-lb. drums, the crystals in 440-lb. bbl.

ZINC DUST—For 350 mesh the New York price is 10c. per lb; Chicago, 13c., Denver, 22c. St. Louis, 15c.

ALUMINUM DUST—Chicago price is 1.10 per lb.

MINERS' LAMP CARBIDE—Prices net f.o.b. cars at warehouse points.

	Union 100-Lb. Drums Per Ton	Cameo 100-Lb. Drums Per Ton	Union 25-Lb. Drum Per Drum
East of the Mississippi, North of Chattanooga	$106.00	$101.00	$1.52
Southeastern portion U. S. A.	115.50	110.50	1.63
Texas (except El Paso)	124.00	119.00	1.74
El Paso, Texas	126.00	121.00	1.77
Denver, Colo	124.00	119.00	1.74
West Coast	129.00	124.00	1.81